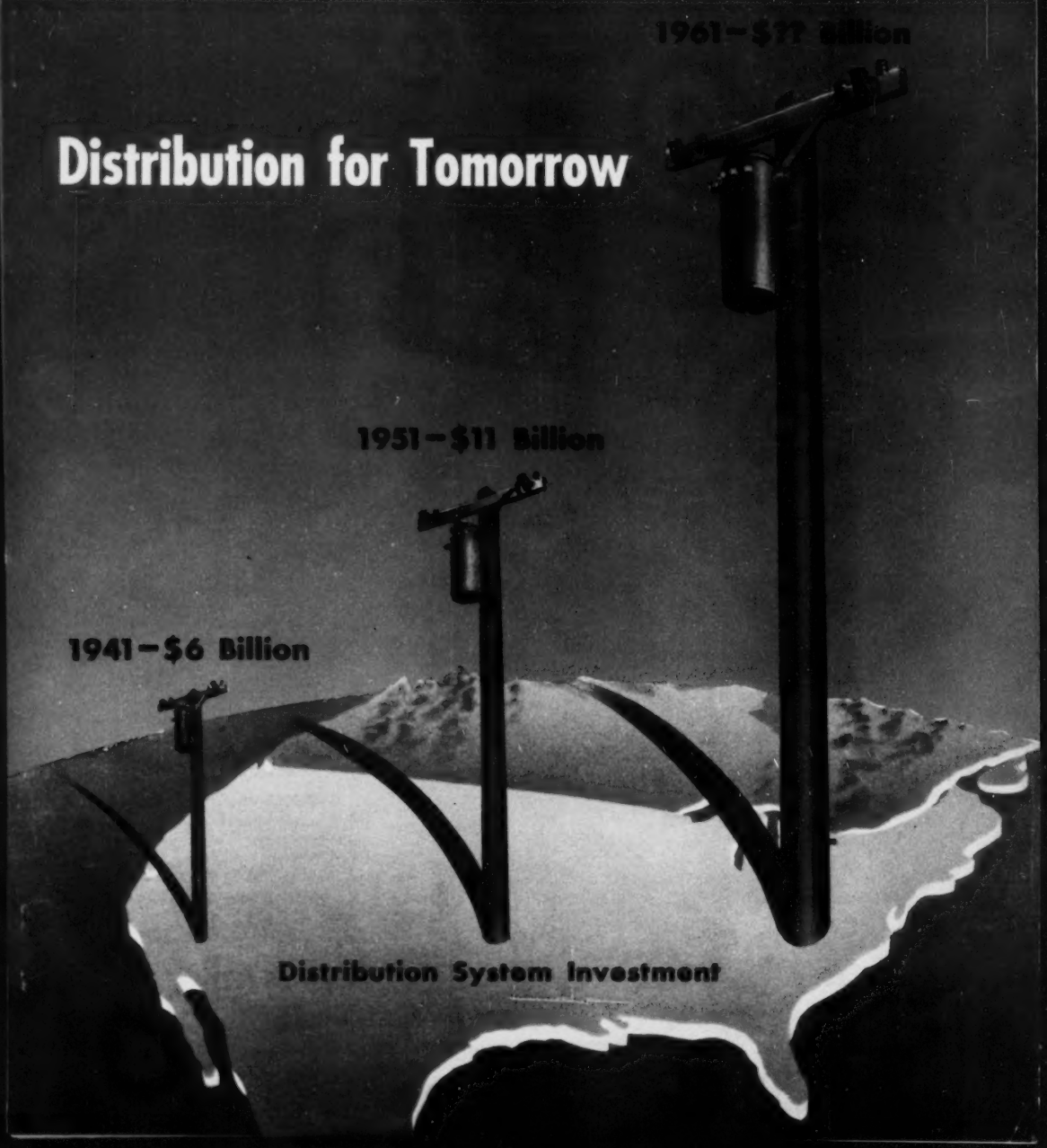
MAY 19, 1952

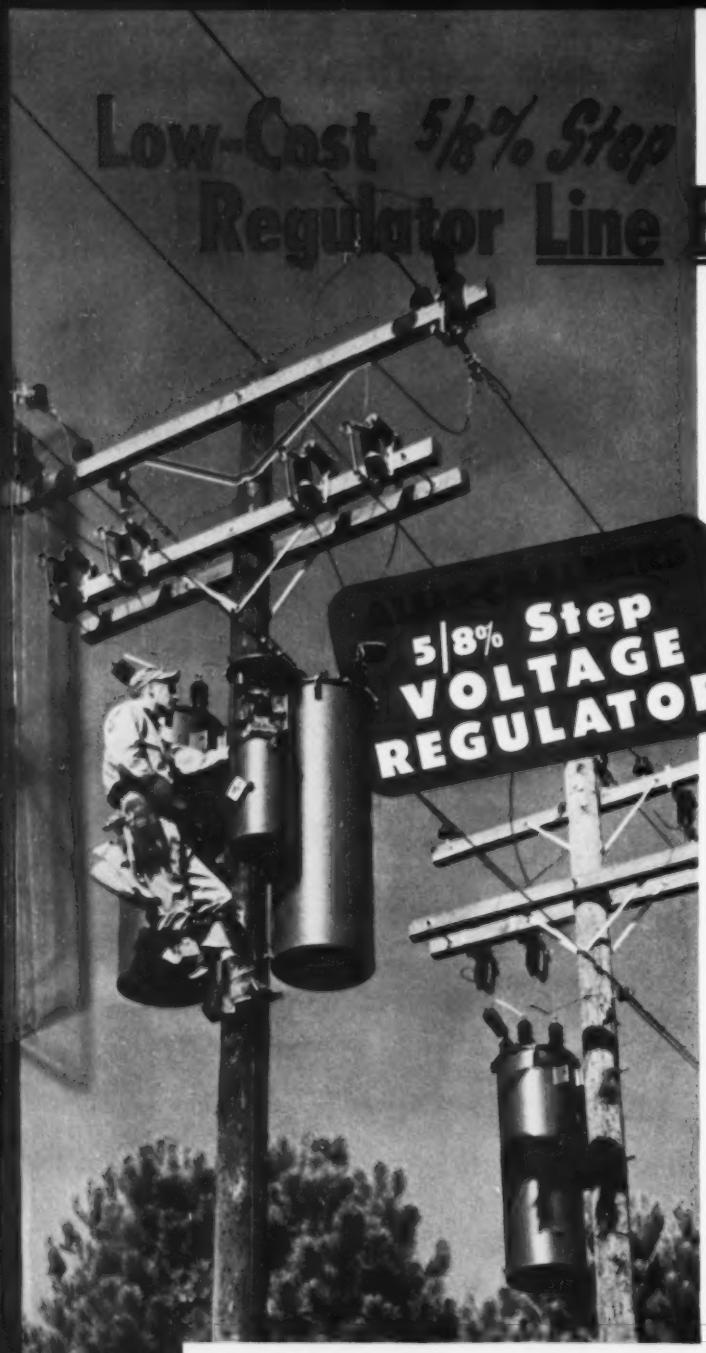
Electrical World

Price 35 Cents

A McGRAW-HILL PUBLICATION

Distribution for Tomorrow





Low-Cost 5/8% Step Regulator Line Distribution Extended

Time-tested JFR regulators can now be used on any feeder

THE EXTENSION of the Allis-Chalmers JFR 5/8% step voltage regulator line to cover five new ratings means that the initial cost of regulation has been reduced for many more feeders. Now you can get time-tested JFR's in the following ratings: 100 amps rated 7620 volts; 50 and 100 amps rated 5000 volts; and 100 and 200 amps rated 2500 volts.

The low price tag on Allis-Chalmers JFR 5/8% step regulator line means that the advantages of voltage regulation can now be brought to marginal lines where equipment costs were too high before. And even though the price tag is low, there's no reduction in quality with the JFR. You get all the advantages of Allis-Chalmers 5/8% step voltage regulation: 5/8% steps, ± 1 volt band, 20% range of regulation, close average voltage maintained by voltage integrator, life long contacts, tap changing and drive mechanism with balanced spring action to eliminate shock, and unit construction for easier maintenance.

Get the complete story on how the Allis-Chalmers JFR 5/8% step voltage regulator line can cut regulation costs for you. Call your nearest Allis-Chalmers district office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3740

RATINGS NOW AVAILABLE

7620 volts	5000 volts	2500 volts
15 amp	50 amp	100 amp
50 amp	100 amp	200 amp
100 amp		

ALLIS-CHALMERS

Originators of 5/8% Step Regulators

NOW IT'S 345 KV!

Transmission line voltages are getting higher. Now it's 345 kv for a line being built by British Columbia Electric Co. Initially some 65 miles long, the line will bring energy from the company's new Wahleach Plant through the Fraser Valley to Vancouver. When first energized about Oct. 1, it will be at 230 kv. In three years or so after additional capacity has been installed at Bridge River Plant, the line will be extended to a total length of 200 miles, and voltage raised to 345 kv. The engineering features and design of this project will be explained in the May 26 issue.

TRAVEL BY AIRPLANE

Louisiana Power & Light Co, serving one of the biggest territories in the country, has solved the problem of getting executives around the system without loss of time. The solution is a company-owned airplane which can carry five passengers and crew at close to 180 miles an hour.

Now members of the headquarters staff can get to the farthest points of the system, complete their business, and return the same day. Previously they often had to drive as long as ten hours to reach their destination as there are no train connections between most of the communities. An amply illustrated story in the May 26 issue gives the details.

PETROLEUM PITCH FOR FUEL

Gadsby Plant of Utah Power & Light Co at Salt Lake City is burning petroleum pitch in its boilers that supply steam for a 66,000-kw unit. The pitch is brought from a refinery 4.5 miles away through a steam heated pipe line. Temperature must be kept at 225 F or the pitch will "freeze." The pitch, a by-product from the manufacture of gasoline and diesel fuel, is much cheaper than coal and has an average heat content of 18,700 Btu per lb.

A second unit of 75,000 kw is now under construction. This will use pitch when available, otherwise coal. Reheat and increased pressure will give the second unit a 3% increase in gross overall efficiency and 750 Btu per kwhr in net heat rate. The engineering thinking behind this unusual plant will be explained in an article in a coming issue.

Electrical World

Published for 78 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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LOW COST METHOD OF ELECTRICAL DISTRIBUTION

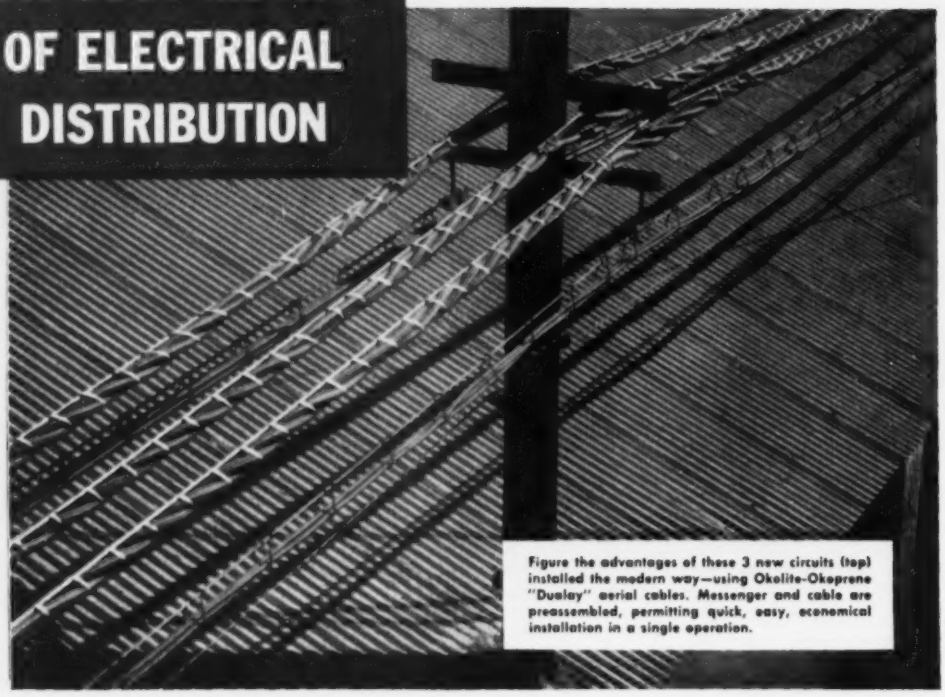


Figure the advantages of these 3 new circuits (top) installed the modern way—using Okolite-Okoprene "Dualay" aerial cables. Messenger and cable are preassembled, permitting quick, easy, economical installation in a single operation.

Okolite-Okoprene self-supporting aerial cable systems can solve a number of electrical cable problems in heavy power-consuming plants.

In such plants as steel, chemical, petroleum, glass, paper—or any fabricating and processing industry—an Okolite-Okoprene aerial cable system offers:

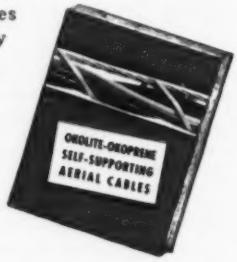
Money-saving advantages over duct systems.

Operational advantages over open wire circuits.

Preassembled Okolite-Okoprene self-supporting cable can be installed in a single operation quickly, easily and economically, often by making use of existing structures. Line taps and splices are simple. And of course there is no need for expensive trenching and ducting.

Because of its extremely high dielectric strength, Okolite-Okoprene gives better voltage regulation, eliminates flashover outages, and provides greater safety to personnel than conventional overhead wiring. Long, trouble-free service is assured by Okonite's famed processing methods. Premium materials, exclusive manufacturing techniques and proved formulas for insulation and sheath, combine to resist attack from moisture, heat, weather, dust- and acid-laden atmosphere.

Bulletin EW-1058 gives 52 pages of facts on why Okolite-Okoprene self-supporting aerial cable is truly an economical buy. Write for it today. The Okonite Company, Passaic, N. J.



The best cable is your best policy

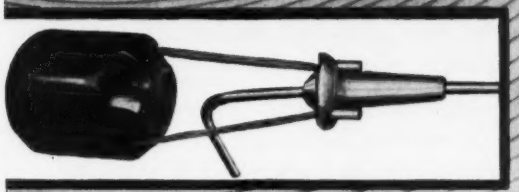
OKONITE SINCE 1878 *insulated wires and cables*

Electroline

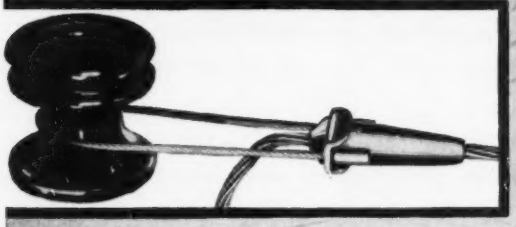
AUTOMATIC DEAD-ENDS

"AS GOOD AS NEW" AFTER TORTURE TEST

Electroline AUTOMATIC DEAD-ENDS are continually subjected to gruelling tests for strength, gripping and vibration damping features. In a typical test, 109,123,000 recorded vibrations did not develop any sign of failure of conductor in these dependable Dead-Ends. Month after month, day and night, these Dead-Ends held their positive grip and retained the full strength of the conductors. Engineers compute that the Dead-Ends withstood the equivalent of 50 years of ordinary service and state that they were as good as new at the end of the test.



3400-SERIES



The 3400-SERIES consists of an Electroline Automatic Connector, a yoke and flexible bail. These three are permanently interlocked once the conductor is inserted to form a complete unit that fits either strain or spool-type insulators.

This series permits the feeding of the conductor through the connector, eliminating the use of taps in the line span. The damping features incorporated in Electroline Dead-Ends prolong the life of conductors by preventing crystallization at the point of connection. They insure full line strength and save on construction costs by their quick and easy installation. These economical Dead-Ends can be reclaimed and used again. But, once installed, the conductor is there to stay; it cannot become detached until released by a lineman.

FOR COMPLETE DETAILS WRITE FOR BULLETIN.

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Electroline Company

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In Canada: POWERLITE DEVICES, LTD., TORONTO

MAKE YOUR *Sectionalizing Switch* ACCESSIBLE

Whether you are putting up a new line—or simply adding a sectionalizing point to an existing line—avoid the limitations of horizontally mounted conventional air switches.

THE "ARC-FREE" ALDUTI INTERRUPTER SWITCH CAN BE MOUNTED VERTICALLY

If it's a "remodelling" job, you can keep service interruptions to a minimum by completing the switch installations with the line *energized.* In fact, interruptions can be eliminated completely if provisions are made for a sectionalizing point when the line is first constructed.

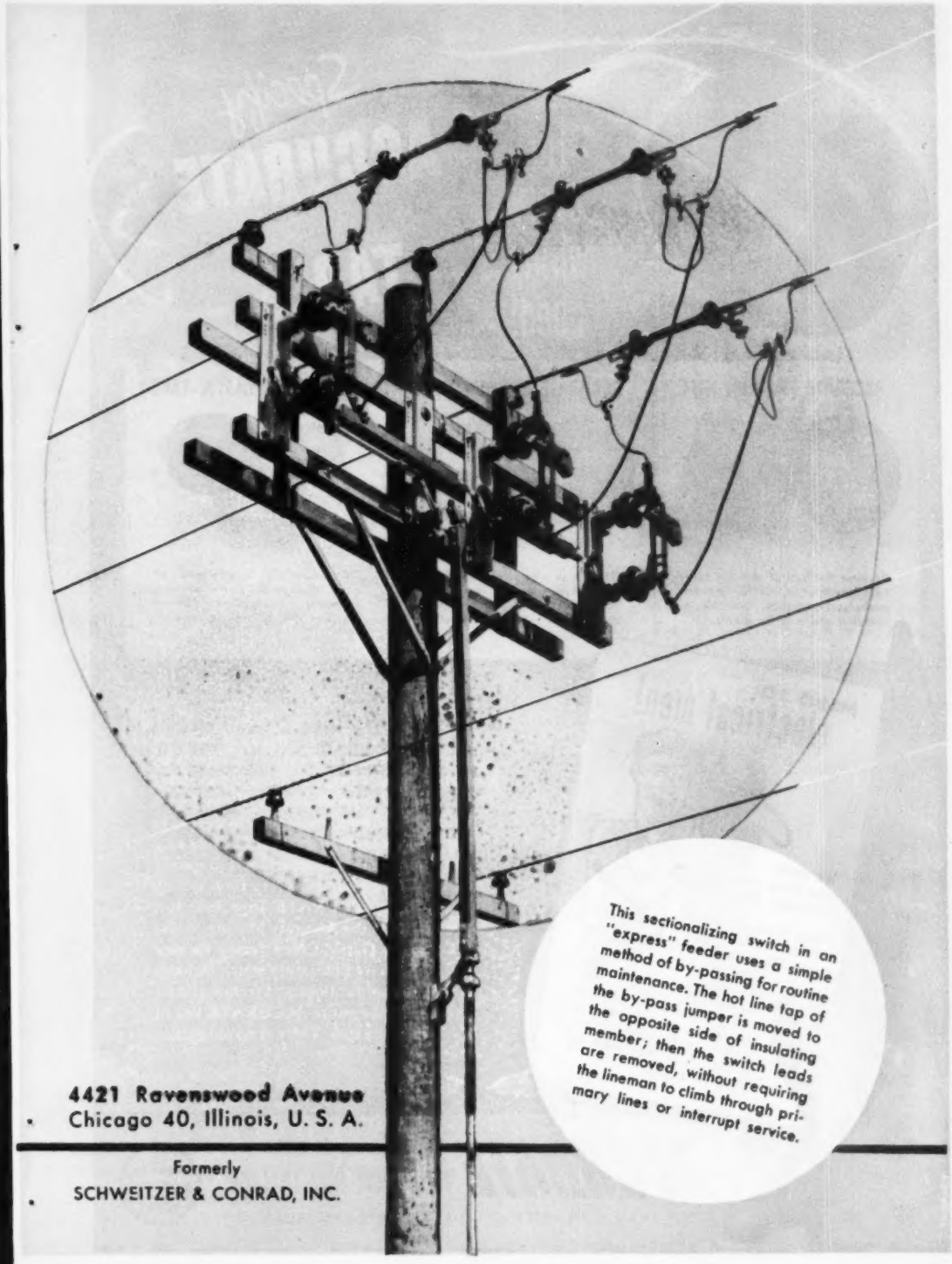
And whether the switch is going into new construction or an existing line, you get the obvious benefits of simple jumpering schemes to by-pass the switch for routine maintenance. Again, no service interruptions!

Of course, that's just part of the picture. Versatility of mounting is simply a by-product of the Alduti's *no-external-arc* switching ability. This switch can safely and positively interrupt line and cable charging currents, and load currents up to 600 amperes. With it you can revise your whole concept of sectionalizing.

Available in voltage ratings from 7500 through 34,500, Alduti Interrupter Switches are shipped in easily handled assemblies for quick installation. Get the complete story. Write for Catalog Section 760, or contact your S&C representative today.

S&C ELECTRIC COMPANY

In Canada, Powerlite Devices, Limited, Toronto



This sectionalizing switch in an "express" feeder uses a simple method of by-passing for routine maintenance. The hot line tap of the by-pass jumper is moved to the opposite side of insulating member; then the switch leads are removed, without requiring the lineman to climb through primary lines or interrupt service.

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Specify ACCURATE TAPES

—for every wiring need!

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Offers high elasticity, high dielectric strength and super aging qualities. Made in both Standard grade and A.S.T.M. — A.A.R. Specification

ACCURATE PLASTIC TAPE

Thin caliper plus a combination of good mechanical and dielectric strengths. Recommended for use wherever plastic tape is practical.

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It's easier and faster with ACCURATE TAPES
Best from all angles — that's Accurate tape. Faster applying because of super workability and cohesion. No heat or pressure, required for Accurate Rubber Tape, either. Try Accurate on your next job.

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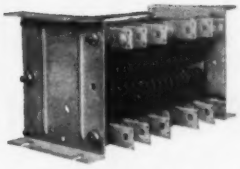
MORE THAN A QUARTER CENTURY OF TAPE SPECIALIZATION

CONTROL *Engineered* to help produce copper

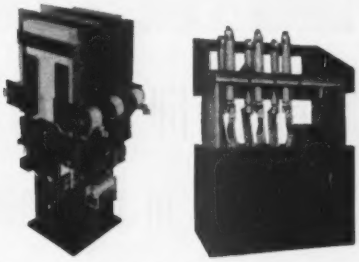
IT TAKES CONTROLLED POWER to process copper ore. Crushing run-of-the-mine ore in this giant jaw crusher, for example, takes a 300-horsepower wound-rotor motor and an Allis-Chalmers Type H Starter engineered especially for extremely high starting inertia and variable loads.

A-3670

THIS STARTER controls the motor to provide smooth acceleration in overcoming the inertia of heavy crusher jaws and large fly wheels. This is accomplished by means of a full automatic starter having six secondary accelerating steps.



EXTRA HEAVY DUTY resistors in the motor secondary circuit provide starting torque and smooth acceleration. Adjustable time delay relays control closing of the accelerating contactors to cut out successive resistor banks . . . automatically bringing the crusher to speed.



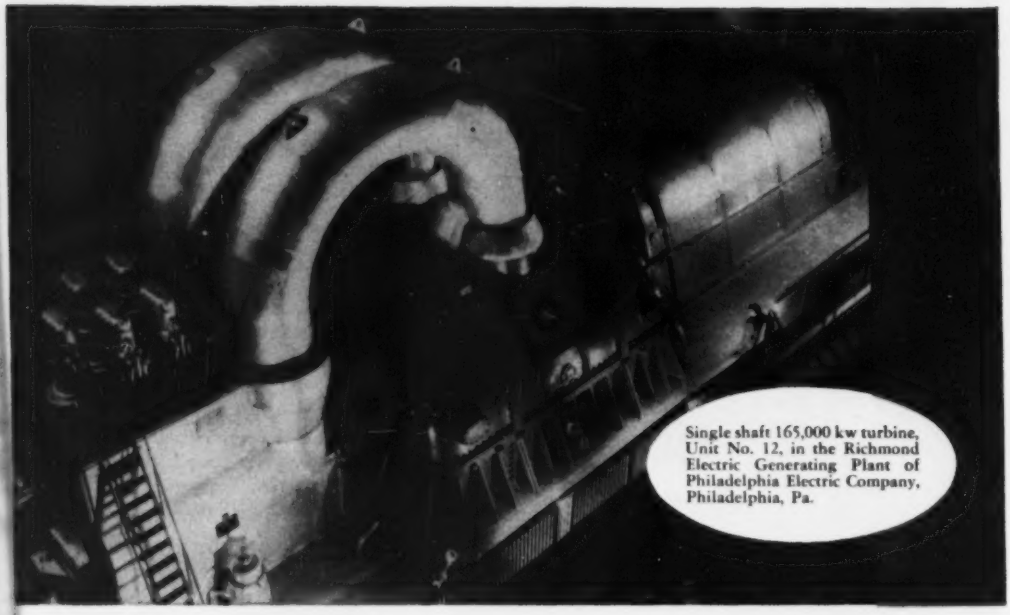
SELECTION OF PRIMARY CONTACTORS for every Allis-Chalmers controller is based strictly on job requirements. Allis-Chalmers high voltage starters have either oil-immersed or air-break contactors as standard.

ALLIS-CHALMERS

There are Allis-Chalmers controllers for use in every industry...starters for squirrel-cage, wound-rotor and synchronous motors. For starters up to 2500 hp at 5000 volts — check with your A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletin 14B6410A.

15 Billion kw-hrs,

a new power producing record!



Single shaft 165,000 kw turbine, Unit No. 12, in the Richmond Electric Generating Plant of Philadelphia Electric Company, Philadelphia, Pa.

Original fill of GULFCREST OIL still in service in this famous turbine after 15 years

More than 15 billion kw-hrs produced in 120,000 hours of almost continuous service! That's a new power-output record for a single turbine unit, according to "Electrical World."

The original charge of Gulfcrest Oil, placed in service in 1936, is still in the lubricating system! And its neutralization number today is only .04.

Another example of the outstanding performance of this great turbine oil! Such a service record is possible because of extra refining by the Gulf Alchlor Process. This exclusive process removes the hydrocarbons most apt to oxidize and form sludge, emulsifiers, and harmful acids in turbine lubricating systems.

Get this same longer-lasting protection for your turbines. Write, wire, or phone your nearest Gulf office today.

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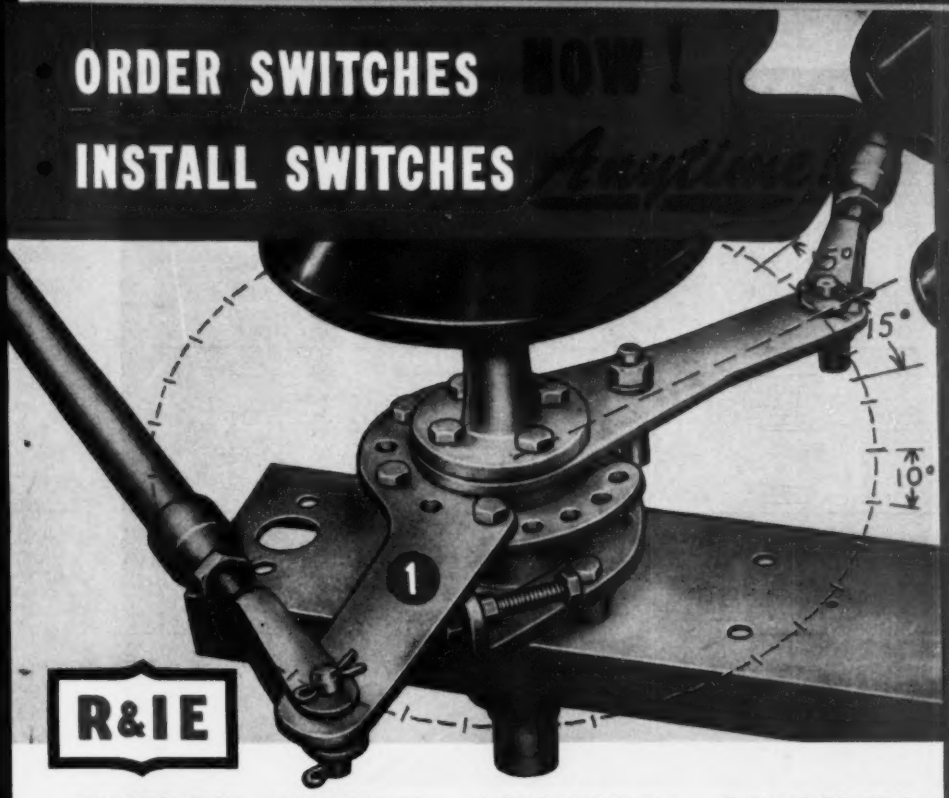
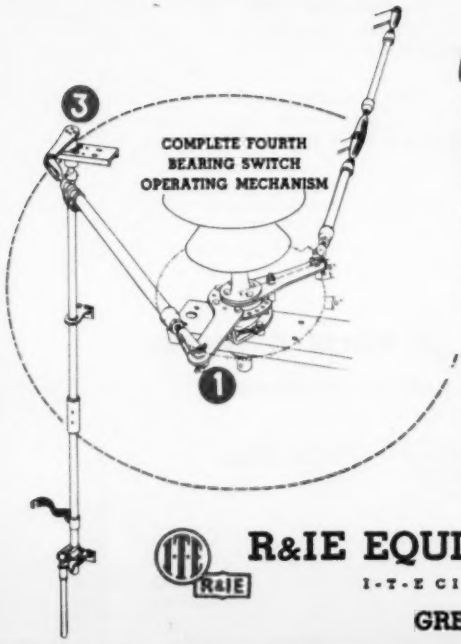
GULF INDUSTRIAL LUBRICATION

ORDER SWITCHES NOW!
INSTALL SWITCHES Anytime



R&IE

MULTI-ANGLE SWITCH CRANKS
Save Engineering and Installation Time!



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1. **UNIVERSALLY ADJUSTABLE**–Permits Angular crank adjustment to within 5 DEGREES of desired operating location.

2. **NO WAITING FOR FINAL STRUCTURAL DETAILS** to order switches. Adjustable features of crank permit switches to be installed at any time on any type structure.

3. **RANGE OF POSITION** — Unlimited. Fourth Bearing can be placed in any desired position on the structure.

4. **MORE DETAIL** found in Bulletin 1405B. Send for your copy.

R&IE EQUIPMENT DIVISION

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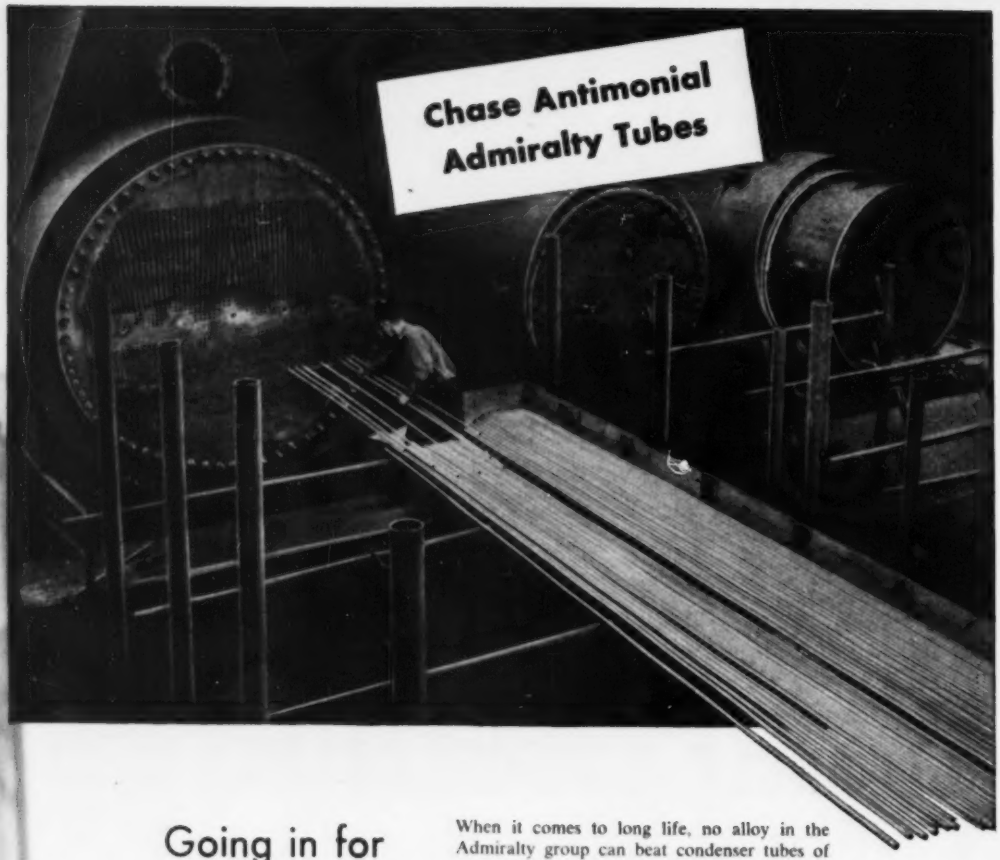
OPEN OR ENCLOSED ISOLATED PHASE HEAVY DUTY BUSES

KIRK INTERLOCK SYSTEMS

AUTOMATIC SWITCHING EQUIPMENT

METAL CUBICLES

TESTING DEVICES



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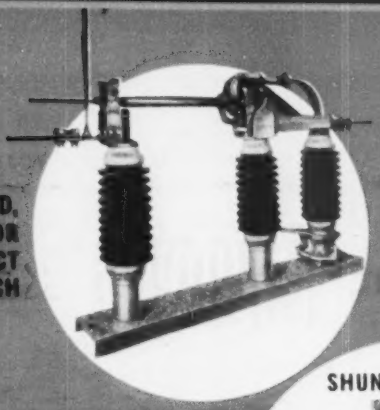
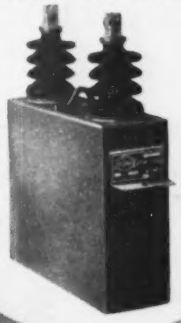


GROUP OPERATED, ROTATING INSULATOR TYPE DISCONNECT SWITCH

SHUNT CAPACITORS



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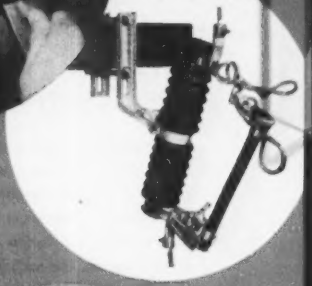
Designed and Engineered with

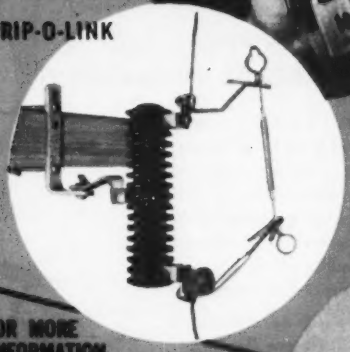
Extra Capacity—in Anticipation of Meeting Today's Ever-Increasing Load Requirements

FUSE LINKS

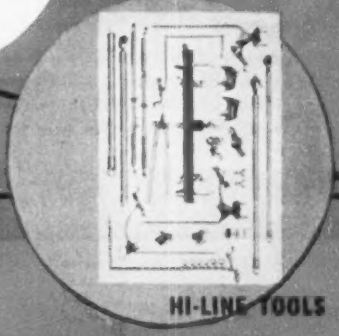
TRIP-OUT



TRIP-O-LINK



FOR MORE INFORMATION concerning this equipment designed for today's heavily loaded lines, SEE FOLLOWING PAGES . . .

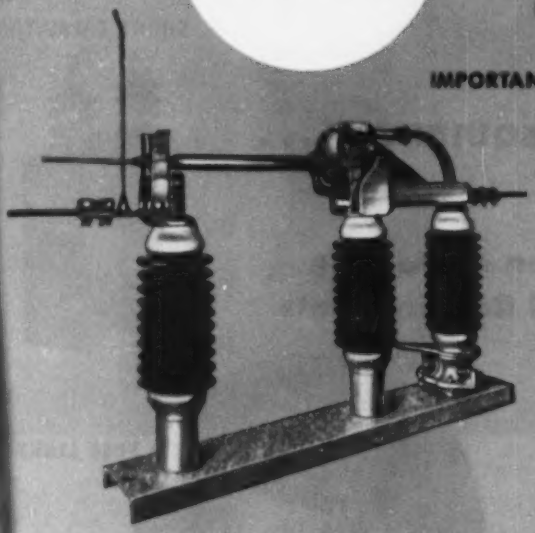


HI-LINE TOOLS

JAMES R. KEARNEY CORPORATION
4224-42 Clayton Avenue, St. Louis 10, Missouri
Canadian Plant: Guelph, Ontario

THE IMPROVED KEARNEY

GROUP OPERATED, ROTATING INSULATOR TYPE, VERTICAL BREAK DISCONNECT SWITCH WITH IMPORTANT DESIGN CHANGES FOR COOLER, MAINTENANCE-FREE OPERATION



These features assure dependable performance under every variety of operating conditions:

1. *Heavy leaf type beryllium copper spring contacts with silver overlay at both ends of blade.*
2. *Fully adjustable to compensate for any changes in switch mounting structure.*
3. *Positive current path to blade through blade contacts at both ends of switch. Hinge mechanism does not carry current.*

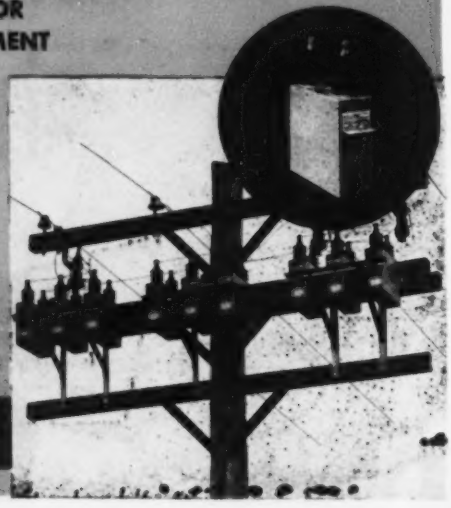
Write for more detailed information. Ask for bulletin No. 8-33.

KEARNEY SHUNT CAPACITORS

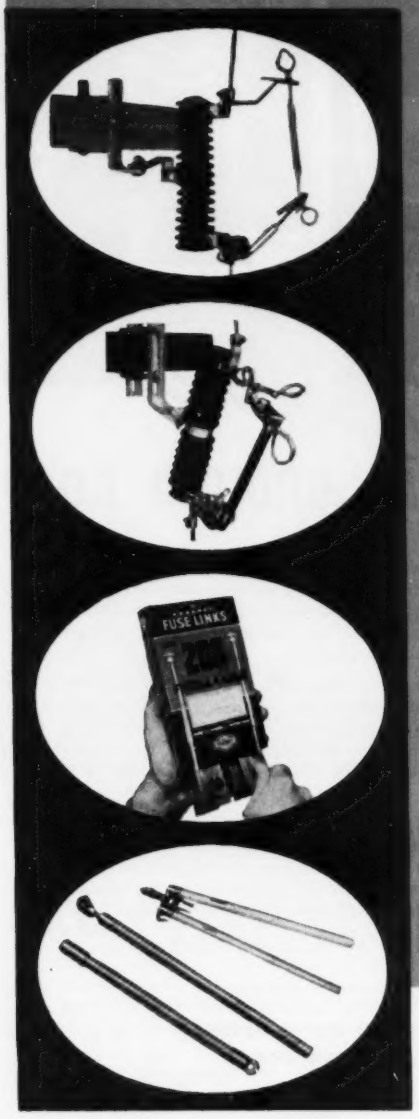
INVALUABLE DEVICE FOR POWER FACTOR CORRECTION AND VOLTAGE IMPROVEMENT

These shunt capacitors correct many undesirable conditions on heavily loaded lines. They release feeder capacity permitting addition of more customers, and increase KW-hours for added revenue, and they release substation capacity in correcting the power factor. The voltage improvement eliminates light flicker and dimness and keeps the voltage within normal operating limits to prevent damage to motors.

Kearney Capacitors feature such advantages as: (1) Protective Packaging, (2) Silicone Gaskets, (3) Askarel Dielectric Oil, (4) Hot Zinc Spray Tank. For additional information, write for bulletin No. 21-1.



Designed and Built with Extra Capacity



For LOW COST PROTECTION
It's the NEW KEARNEY TRIP-O-LINK

This new design features an additional petticoat for greatly increased insulation. With TRIP-O-LINKS' plated terminals you can accommodate either copper or aluminum wire with no danger of galvanic action, thus helping solve conductor problems in the event of a shortage.

The KEARNEY TRIP-OUT with Silver-to-Silver Contacts Accommodates Heavier Loads and Preserves Current-Carrying Efficiency

For heavy current faults there is no better open-type switch on the market today. The TRIP-OUT can be converted to a disconnect switch by the substitution of a disconnect blade for the fuse cartridge. All Kearney fuse cutouts are designed for this conversion.

KEARNEY TYPE 200 FUSE LINKS

For high, safe overload capacity, the Type 200 Fuse Link has no equal. These links open at approximately 200% of their continuous current rating in about 5 minutes. Good cutout performance depends a great deal upon the fuse link used. So, for maximum protection specify KEARNEY on your next fuse link order.

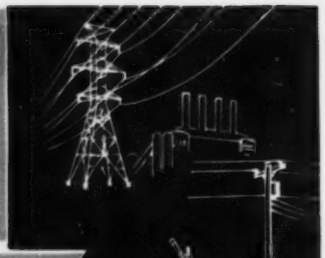
For Maximum Protection on Working Energized Lines—Use KEARNEY PLASTICKS

Check the many advantages of Kearney plastic-covered sticks over the conventional varnished variety before buying hi-line tools. Ask your Kearney Salesman or write for catalog.

JAMES R. KEARNEY CORPORATION
4224-42 Clayton Avenue, St. Louis 10, Missouri
Canadian Plant: Guelph, Ontario

KEARNEY *Gives a little More for a little Less* — *Through Engineering*

OUT with Costly Outages!



GET PERMANENT DEEP-DOWN PROTECTION WITH Copperweld

Removable stud bolt takes driving blows
Threaded bronze coupling
Any of these Copperweld Sectional Rods may be used as a top, intermediate, or bottom section. They are roll-threaded on both ends.
As each Copperweld Sectional Ground Rod is driven, the next rod is joined to it by means of a heavy bronze coupling, and the driving procedure is then repeated. It's as simple as that.

SECTIONAL GROUND RODS

In most localities deep grounding will provide low resistances more economically than multiple shallow grounds. More and more engineers are turning to Copperweld* Sectional Ground Rods for this deep-down protection. These superior ground rods do the job quickly, permanently and at low cost.

Copperweld Sectional Ground Rods have a stiff alloy steel core to provide the rugged strength for easy driving. This core is permanently protected from corrosion by a thick, molten-welded layer of copper having high conductivity. No other ground rod has this inseparable molten-weld which eliminates the possibility of electrolytic action.

Whether you drive only a few lengths by hand or penetrate the earth's sub-surface with the aid of a power hammer, you can do it quicker, better, and at low cost with Copperweld Sectional Ground Rods. And at the same time, you'll get permanent and consistent low-resistance grounding protection against costly outages.

*Trade Mark

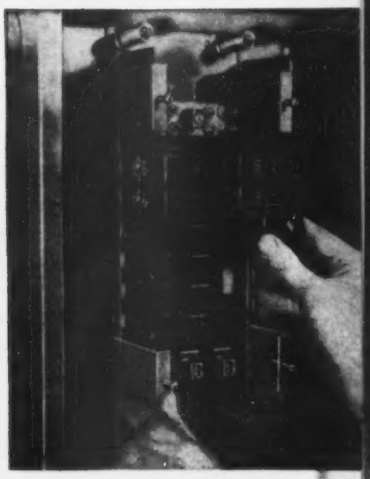
HOW TO DRIVE DEEPER AND AT LOW COST

Equipped with a demountable steel framework supporting a Barco gasoline hammer, this truck is demonstrating that effective, low-resistance deep grounding can be accomplished in a simple, economical manner with Copperweld Sectional Ground Rods. You can readily duplicate this rig in your own shops. Complete plans will be mailed to you upon request.

Made by
COPPERWELD STEEL COMPANY
Glassport, Pa.

THEY'RE MOLTEN-WELDED Copperweld GROUND RODS

Stocked And Sold By:
HUBBARD AND COMPANY • JOSLYN MFG. & SUPPLY CO.
And All Their Distributors



ANOTHER TALKING POINT IS THE BREAKER—Trumbull's new NLTQ Panelboard introduces the first *plug-in* circuit breaker with quick-make, quick-break operation. Other features: both *thermal* and *magnetic* protection . . . trip-free . . . pressure-type, silver-plated copper plug-in contacts . . . all ratings physically interchangeable. Adjacent breakers are on alternate phases—assuring balanced loads and circuits.

New insulating material

MAKES PANELBOARD SALES!

The base of this panelboard interior is made of *Plastisol* . . . the first time this amazing plastic material has been used for this purpose.

Here are some reasons for your recommending Trumbull's new NLTQ Panelboard to your customers.

Plastisol has very high thermal conductivity and is an excellent radiator of heat. Copper bus bars encased in Plastisol run 10% cooler than in open air!

SALES POINTS THAT OUT-SELL OTHER INSULATION

Other Plastisol advantages making it superior to all other types of insulation for this purpose include its ability to resist acid and alkali, high temperatures (not harmed at 212 F), tracking and carbonizing. It will not shrink or become brittle, even at minus 30 F.

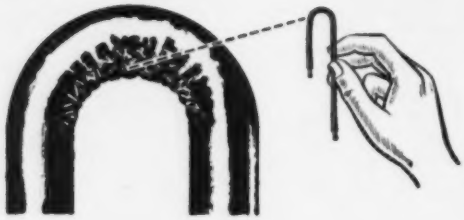
Trumbull's Plastisol base is Underwriters' Laboratories, Inc. approved and endorsed by the Electrical Council.

YOUR CUSTOMERS WILL LIKE QUICK INSTALLATION—Interior is mounted in box by compression springs . . . which permit easy release for removal. Springs also permit lining up fronts regardless of uneven box installation. Trumbull NLTQ panelboards with lug or circuit breaker mains come in capacities up to 225 amperes in a range of 4 to 42 circuits. Write for Bulletin TEB-14.

TRUMBULL (T) ELECTRIC

DEPARTMENT OF GENERAL ELECTRIC COMPANY
PLAINVILLE, CONN.

Insulating a bend?



When electrical insulation must take a bend you need BH "649"—to prevent dangerous dielectric loss and resulting product failure. Proof of BH "649" product protection is demonstrated in the following test:

To simulate actual operating conditions, lengths of BH "649" Fiberglas Tubing, Grades A-1 and B-1, and Varnished Cotton-base Tubing, Grade A-1, were slipped over wires of the corresponding Awg size. The samples were bent to a "U" with an approximate $\frac{1}{2}$" radius and then baked for 96 hours at 221°F. Visible failure occurred at the bend of the Varnished Tubing, none in the BH "649" samples.

Here is what happened when the samples were tested for dielectric strength:

	VARNISH COTTON-BASE TUBING A-1	BH "649" FIBERGLAS TUBING A-1	BH "649" FIBERGLAS TUBING B-1
AVERAGE ORIGINAL DIELECTRIC STRENGTH	12,200 volts	10,400 volts	8,200 volts
AVERAGE DIELECTRIC STRENGTH AFTER BEND TEST	1,000 volts	9,400 volts	5,200 volts

This is superior proof of only *one* BH "649" feature — there are many others — that's why you'll find BH "649" in equipment that must not fail, whether in appliances for consumer use or complicated electronic equipment.

BH "649" is permanently flexible. It will stand bending and mechanical abrasion without splitting, cracking or fraying. Resistance to oil, water and most chemicals is unusually high. Does not corrode metals. Age has no effect on its physical or dielectric properties. It will not ravel when cut — permanently rounded, it handles easily and speeds installation. Spreads to cover knobs, terminals and irregular objects.

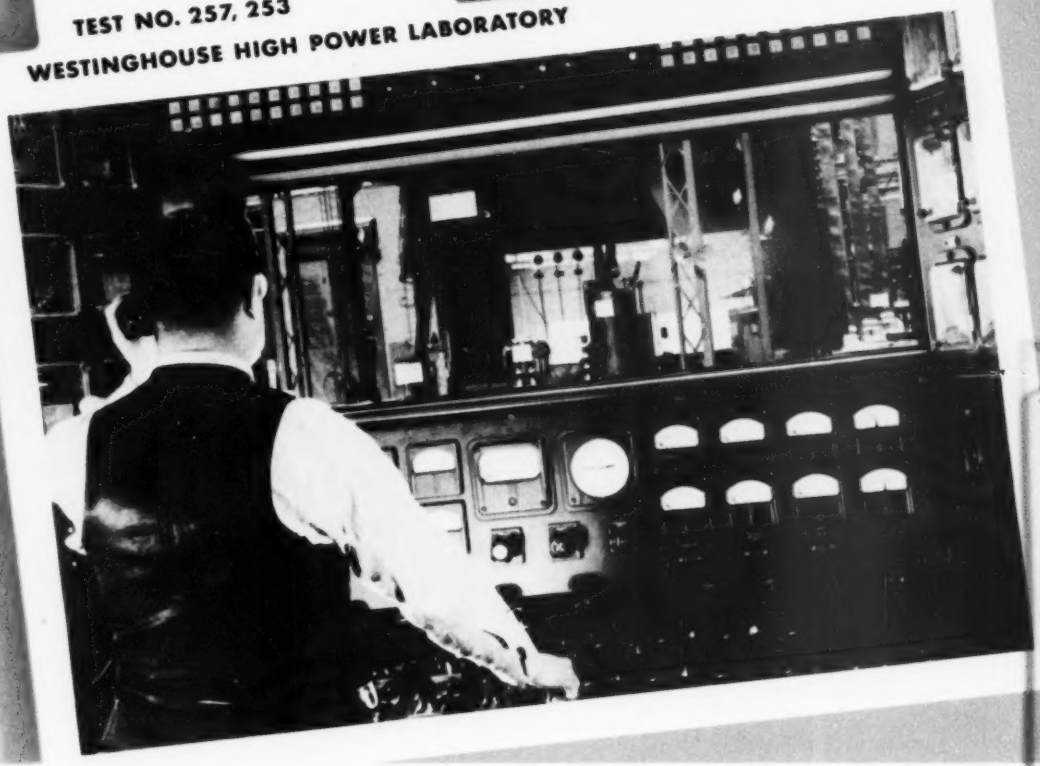
BH "649" is only one of a family of electrical insulations, each designed to meet particular conditions in service. Give us a few facts about your requirements — product, temperatures, voltages — we will gladly furnish samples for testing purposes.

Address. Dept. W-5

BENTLEY, HARRIS MANUFACTURING CO.
Conshohocken, Pa.

BH *Fiberglas** SLEEVINGS

*BH Non-Fraying Fiberglas Sleevings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2393530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.



COMING UP . . TEST No. 257, 253 . . and a NEW BENEFIT for you!

Twenty-seven years ago an engineer closed a switch and a heavy current surged through a breaker. This was Test No. 1 in the Westinghouse High Power Laboratory. Through the years, over 255,000 tests have been made in this laboratory to prove every advance in Westinghouse Switchgear design.

A documentary record has been maintained of every test in this laboratory since 1925, to provide a fund of factual data and cumulative knowledge. Included in this vast file of readily available records and reports are tests of every one of the complete line of circuit breakers—indoor and outdoor, air and oil, floor and frame-mounted—and of numerous other products such as metal-clad switchgear, disconnecting switches, isolated phase bus, etc.

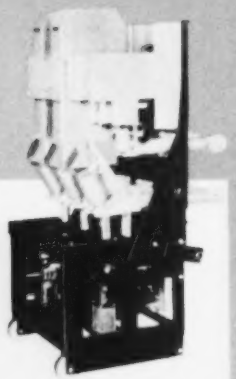
Now comes Test No. 257,253 on a power circuit breaker. From the test record will come factual data on the operating performance of this breaker design and a permanent record to supplement the cumulative knowledge obtained from the laboratory's previous tests. Thus Westinghouse is constantly in a position to build improved products for your present and future requirements.

HIGH POWER LABORATORY TESTING CREATES BETTER PRODUCTS FOR YOU

See "Electrical Proving Ground" . . . the dramatic story of the Westinghouse High Power Laboratory in sound and color motion picture. For details see your Westinghouse representative, or write Westinghouse Film Division, Box 868, Pittsburgh 30, Penna.

ELECTRICAL PROVING GROUND

WESTINGHOUSE SWITCHGEAR *is Design-Proved to the Last Detail*



DESIGN TESTED AND VERIFIED in the Westinghouse HIGH POWER LABORATORY

When you install Westinghouse Switchgear you are providing the *surest* protection available for your system. You have assurance of dependable performance because all Westinghouse Switchgear designs have been tested and verified in the Westinghouse High Power Laboratory.

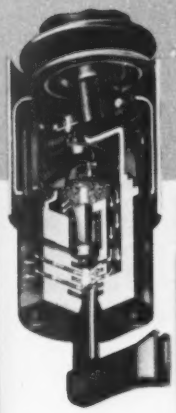
Breaker designs are tested to prove their adequacy within their rating. The cell structure has demonstrated its ability to withstand the stresses resulting from fault current. Venting of arc gases, bus bracing, bus insulation, instrument transformers, disconnecting contacts—every switchgear component—has been checked and found adequate in tests duplicating the most severe service conditions.

Knowing that your switchgear design has been verified in the Westinghouse "Electrical Proving Ground" is a matchless advantage. It's one you always get when you specify . . . Westinghouse.

Complete information on Westinghouse Switchgear is contained in Booklets B-5282 (Low-Voltage), B-5306 (Metal-Clad) and B-3285 (Station Cubicles). For your copies write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

YOU CAN BE SURE... IF IT'S

The seal that safeguards your investment



WESTINGHOUSE OIL CIRCUIT BREAKERS *feature Exclusive Laboratory Developed De-ion® Grids*

In its 27 years of operation, the Westinghouse High Power Laboratory has given you many important developments such as the De-ion Grid. As an exclusive feature of all Westinghouse oil breakers, the De-ion Grid answers your need for higher interrupting capacities and faster interruption of line faults.

The secret of faster interruption is the multiflow principle of the De-ion Grid which produces an extremely high rate of deionization of the arc space at current zero. Moreover, this faster interruption is accompanied by reductions in the arc energy and lower mechanical stresses and tank pressures. This makes possible the lower oil content breakers, such as the "Watch-Case" breaker shown above.

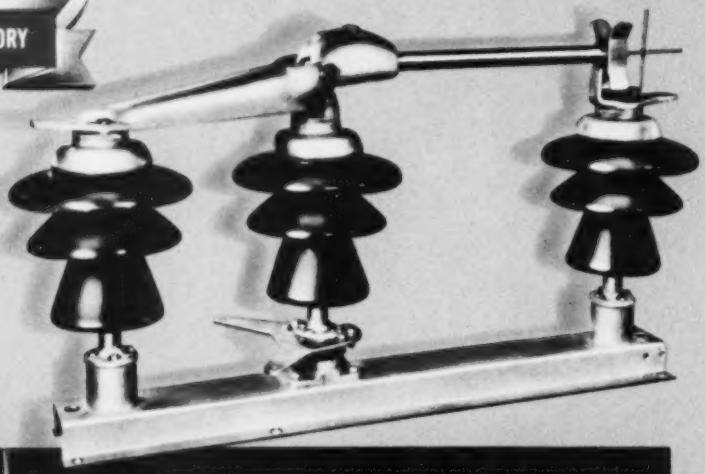
The growth and interconnection of high-voltage transmission systems and high concentration of generating capacity emphasize *your need* for *proved* protective equipment. You *can* be sure when you specify Westinghouse Power Circuit Breakers.

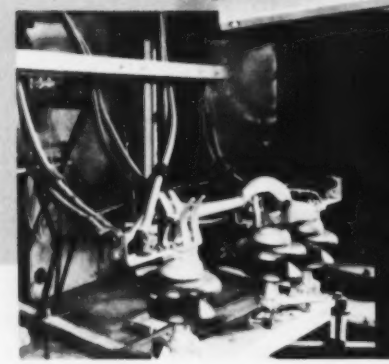
Complete information on Westinghouse Power Circuit Breakers is contained in Booklets 3686A (15 to 69 kv) and 4012 (115 kv and above). For your copies, write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

Westinghouse

DESIGN TESTED AND VERIFIED in the Westinghouse HIGH POWER LABORATORY

The seal that safeguards your investment





WESTINGHOUSE TYPE V SWITCH...

Laboratory-Proved Leader in Disconnect Field!

The development of the Type V Switch gave you a disconnecting device of unequaled dependability. A departure from conventional switch design, the Type V provided for the first time enclosed pole-unit parts, single-piece break jaws, oilite bushings and single-line high-pressure contacts—without troublesome flexible shunts.

Tested at the Westinghouse High Power Laboratory, the new design was proved at basic impulse insulation levels . . . at NEMA Standard short-time ratings (illustrated) . . . for temperature rise at rated current . . . and for operation under severe icing conditions. And these tests are the same as those which have proved every rating and new design in the entire Westinghouse Switch family. So whatever your disconnecting switch application may be, you can be sure of lasting dependable performance when you specify . . . Westinghouse.

Booklet B-4726 contains information on all Westinghouse Disconnecting Switches. For your copy write: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-60780

YOU CAN BE **SURE**... IF IT'S Westinghouse

WESTINGHOUSE ELECTRIC CORPORATION

EAST PITTSBURGH, PENNSYLVANIA

LOOK into the future of your pole-line construction

build with

Life Span

Life Span

Life Span

LIFE-SPAN
WESTERN RED CEDAR POLES

There's a long future ahead for every LIFE-SPAN Western Red Cedar Pole you install! The LIFE-SPAN treatment does the entire end-to-end pole preserving job and adds years of service to your pole-line construction.

LIFE-SPAN Western Red Cedar Poles are straight, strong and clean. The hot and cold LIFE-SPAN treatment from top to butt preserves the sapwood to its full depth, giving each pole complete immunity to decay organisms and wood-eating insects. No added ground-line treatment is ever needed!

Ask the lineman! He likes LIFE-SPAN Poles because they are clean, easy to handle and safe to work on. Ask the utility company executive! He prefers them because they offer longer, more dependable service—build good public relations for his company.

When you're planning pole-line construction, *specify* LIFE-SPAN Western Red Cedar Poles. Write any of the companies listed for complete information.

Life Span

SOLD ONLY BY THE FOLLOWING:

B. J. Carney & Co.
Spokane—Minneapolis

Schaefer-Hitchcock Co.
Sandpoint, Idaho
(Suppliers for Joslyn Mfg. & Supply Co.)

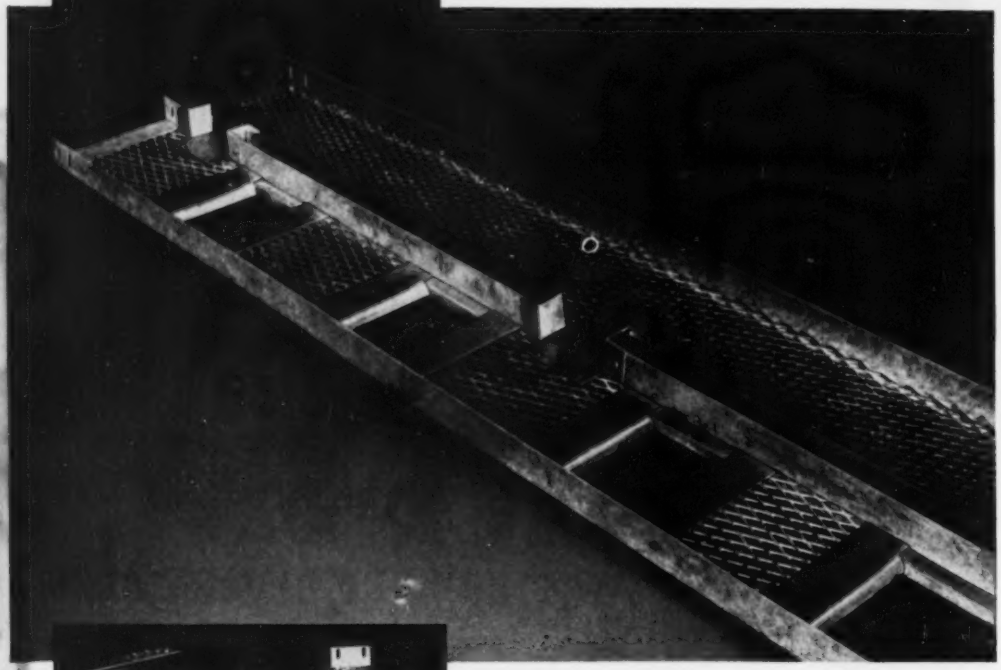
Naugle Pole & Tie Corp.
Chicago, Illinois

Page & Hill, Inc.
Minneapolis, Minnesota
50 Church St., New York, New York

CONSOLIDATED TREATING CO.
MINNEAPOLIS MINNESOTA

This message is for you...

HAVING UNUSUAL PROBLEMS WHICH REQUIRE SPECIAL DESIGNS OF CABLE TROUGH



T. J. Cope INC.

YOU KNOW COPE BY THESE PRODUCTS

There are many cases where installation of cable trough creates this "puzzling problem": *How* should it be designed to fit a particular situation?

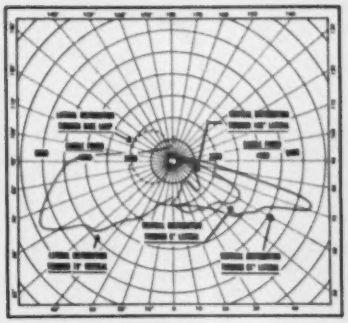
That needn't cause you any worry, though, because Cope is solving such individual problems daily. Where a Design Engineer is concerned over a "perplexing situation", all he has to do is outline the problem to our Engineering Staff, and the solution comes from us. Cope Engineers design special fittings which adapt the standard Troughs to your specified job.

We offer you the services of our Engineers when special fittings are required, and urge you to submit your problems to us.

You will quickly discover—as have hundreds of users—that the new Cope Cable Trough with its simplified design actually saves you *three ways*: material, labor and costs.

Request full information on Cope Cable Trough from us today.

T. J. COPE, INC., 711 SOUTH 50th ST.
PHILADELPHIA 43, PENNSYLVANIA



The L-M *Ovalite* takes either incandescent or horizontal-burning mercury vapor lamps. Mercury lamp is high up in the reflector. This, combined with the design of the HOLOPHANE® refractor, results in low surface brightness and less glare, and a broad light-distribution pattern as shown by the curves in the chart.

New design of L-M Ovalite gives improved light distribution for mercury vapor

The new *Ovalite* is designed for high intensity lighting over a wide area. The rectangular Alzak reflector provides asymmetric light distribution. An Alzak deflector passes the light down around, not through, the lamp. Prisms on the house side of the Holophane refractor re-direct the light toward the street. Optional magnetic arc-control feature holds the arc in the optical center.

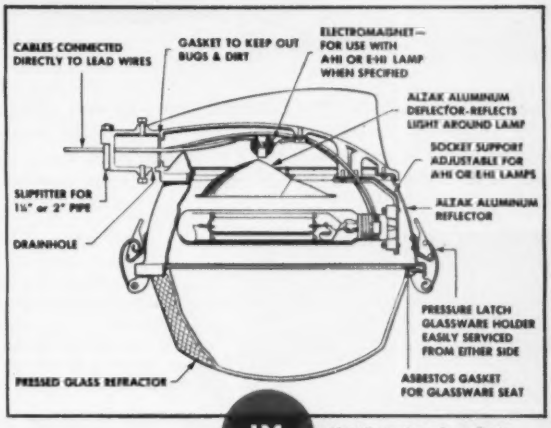
Lower mounting height—Unlike mercury vapor units with narrower distribution, the *Ovalite* provides wide IES type IV distribution. This means that the *Ovalite* is effective at lower mounting heights of 25 to 30 feet, which saves pole costs and maintenance. The use of elevating prisms in the refractor results in low surface brightness and minimum glare.

Unusual easy-service feature—Pressure latches on both sides hold the glassware snugly. Either latch acts as a hinge when the other is opened, permitting service from either side. An exclusive L-M feature.

Pendent or side-mounted, for either mercury or incandescent—The *Ovalite* takes mercury vapor E-H1, 20,000 lumens; A-H1, 15,000 lumens; or A-H5, 11,000 lumens; or incandescent lamps up to 15,000 lumens series. Slipfitter and pendent mountings in 1¼" or 2" sizes.

GET THIS FREE OVALITE BULLETIN

The *Ovalite* bulletin provides details on design, use, types, ballasts. Ask your L-M Field Engineer for a copy or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).


CABLES CONNECTED DIRECTLY TO LEAD WIRES
GASKET TO KEEP OUT BUGS & DIRT
ELECTROMAGNET—FOR USE WITH A-HI OR E-HI LAMP WHEN SPECIFIED
ALZAK ALUMINUM DEFLECTOR-REFLECTS LIGHT AROUND LAMP
SOCKET SUPPORT ADJUSTABLE FOR A-HI OR E-HI LAMPS
SLIPFITTER FOR 1¼" or 2" PIPE
ALZAK ALUMINUM REFLECTOR
DRAINHOLE
PRESSURE LATCH GLASSWARE HOLDER EASILY SERVICED FROM EITHER SIDE
PRESSED GLASS REFRACTOR
ASBESTOS GASKET FOR GLASSWARE SEAT

Note the rectangular reflector, the deflector, and the mounting of lamp well up in the reflector.

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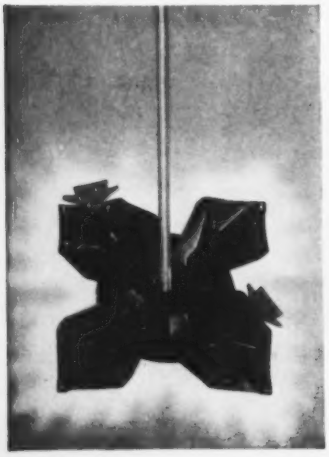
LINE MATERIAL

Street Lighting

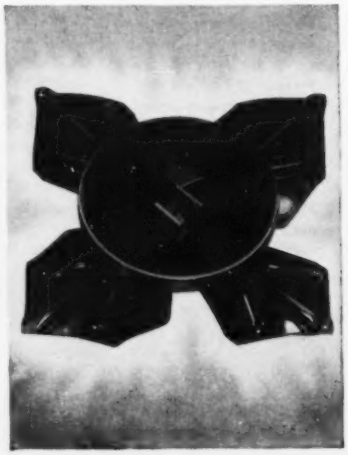
Ovalite is an L-M trademark

Two-piece design . . . The four blades are formed of a single piece of steel, and are held to the base plate by four small bolts, which simply shear off by tamping. The center hole is extruded downwards. This extrusion provides a bearing surface against the rod to prevent binding; it reinforces the tamping area; and it provides an audible signal when the extrusion strikes the base, indicating full expansion.



Top view . . . Notice the additional area inside the center of gravity of two opposed blades which gives utmost area for increased holding power, without sacrificing balance of the anchor.

Base plate . . . .Heavy steel, with skirted edge to prevent deformation. A nut retainer strap welded to the underside reinforces the hole so that the nut cannot pull through the base plate.



Anchor closed . . . Notice the large square tamping area, and the wide hinge sections which keep the blades from twisting if a stone is encountered while the anchor is being expanded.

Partly open . . . Arched, shovel-shaped blades slide into the earth with a minimum of soil disturbance. Heavy ribs on the underside decrease friction between blades and base plate.

Fully expanded . . . A large percentage of the expanded area is in undisturbed earth. Therefore load can be applied to the anchor immediately after installation, with little danger of creepage.

L-M's New 4-Way Pressed Steel Anchors Designed for Exceptional Strength

L-M has recently completed an extensive series of tests that reveal exceptional strength and holding power in the new 4-Way anchors.

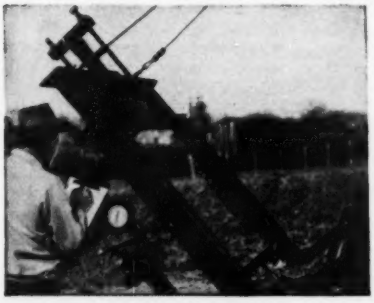
These anchors are easy to install. They have ample holding power above their nominal ratings. There is a generous safety factor in mechanical strength of all parts. And the cost is low!

The design offers many desirable features. A large square tamping area is well reinforced by the downward extrusion of the anchor rod hole, which also provides a bearing area against the rod. Arched, pointed blades slide into the earth without disturbing it, permitting application of the load right after installation. Heavy ribs reinforce the blades and reduce friction against the base plate during expansion. Nut retainer strap reinforces the base, and keeps the nut from pulling through. All three sizes are REA-accepted.

For details and samples ask the L-M Field Engineer; or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

Available in Three Sizes

Catalog No.	20002481	20002482	20002483
Expanded Area, square inches	110	125	132
Nominal Holding Power Class, pounds	6000	8000	10,000
Diameter, closed, inches	8	8	8
Anchor Rod Diameter, inches	½, ⅝	½, ⅝	1
Minimum Strength of anchor without deformation, pounds	16,000	21,000	24,000



Hydraulic lift mounted on U-shaped steel frame with pump and pressure gauge for recording the pounds of pull applied to anchor rod. Tests at vertical and 45° angle showed ample mechanical strength of all parts, well balanced against holding power.

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LINE MATERIAL

Line Construction Materials

Complete Coordinated Equipment for Distribution Today

LET'S LOOK AT THE FACTS

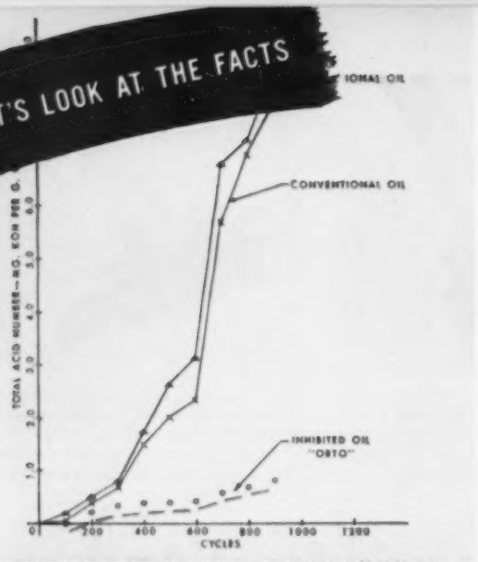


FIGURE 1—Comparison of acids formed by inhibited (ORTO) oil and conventional transformer oils in laboratory tests. Reduction of acid formation increases the life of the oil two to three times, and prolongs the life of the cellulose insulation.

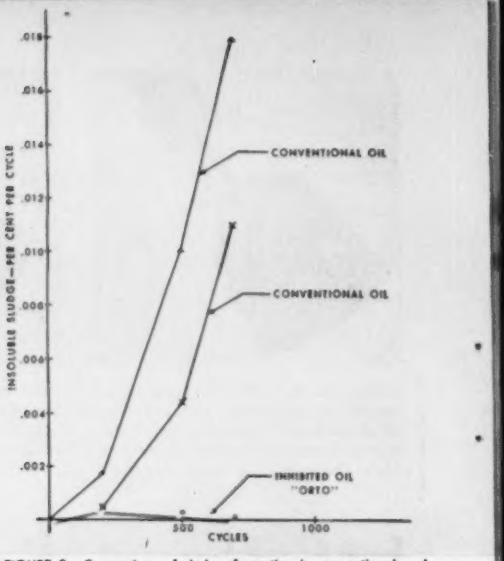


FIGURE 2—Comparison of sludge formation in conventional and inhibited (ORTO) oils in laboratory tests. The prevention of sludge formation appreciably lengthens life of the oil and the transformer, and maintains high overload capacity.

L-M's ORTO® Lengthens Transformer Life and Increases Overload Capacity

by **MARTIN I. ZWELLING,**
Chief Laboratory Engineer,
Transformer Division, Line Material Co.

The life of a transformer is largely determined by the life of the cellulose insulation. This, in turn, is dependent upon temperature of operation, formation of acids, and the length of time these two reactants are in effect.

Obviously the prevention of acid by an inhibitor eliminates one reactant (Figure 1). The prevention of sludge (Figure 2) modifies the other—temperature—by permitting free oil circulation, and thus keeps cellulose deterioration at a low rate. Surge strength and short-circuit strength are maintained at high levels throughout the transformer's life span.

Maintains Overload Capacity

Generally speaking, inhibited oil will improve overload capacity by maintaining the original capacity of the transformer over a greater proportion of its life. Actually, in high magnitude, short duration overloads, the temperature of the oil does not increase to any great degree, and heat affects only the cellulose insulation. But if the prevention of acid formation has protected the cellulose insulation from deterioration, the transformer is better able to handle a high short-time overload without damage.

In the case of long time, low magnitude overloads, the use of an inhibited oil such as ORTO has an even more marked effect. In conventional oils, overload capacity will be decreased as oxidation builds up increasing amounts of acid and blanketing layers of sludge (Figure 3). By preventing the formation of acids and sludge, the transformer maintains its initial high overload capacity for a greater proportion of its life (Figure 4).

Lengthens Transformer Life

If an operator obtains a certain life expectancy from a transformer under certain operating conditions, life will be increased with an inhibited oil under these same operating conditions. Or, with the same operating conditions and the *same life expectancy*, a certain increase in the overload is possible with ORTO.

Long term tests (Figure 5) and short term accelerated tests (Figure 6) have been made which show a marked degree of correlation (Figure 7). These tests indicate that the inhibitor in ORTO greatly prolongs oil life before acid and sludge deterioration commences, and that after this deterioration starts, ORTO follows the same gradual curve of any high grade conventional oil (Figure 8). The inhibitor has no harmful effects, it does not react with any other known inhibitor, and it may be blended with other oils, new or reclaimed, inhibited or non-inhibited. Naturally when ORTO is blended with another oil a certain amount of dilution occurs which reduces the effective life-extension properties of the inhibitor to the extent that ORTO is diluted. The overall effect of ORTO can be safely judged from the diagram.

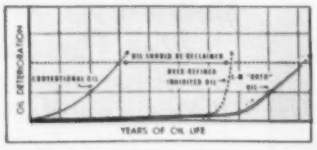


FIGURE 8—Comparative curves show the deterioration in service of a conventional oil, an inhibited over-refined oil, and ORTO brand oil, in which deterioration, when it finally starts, follows the same gradual curve as any high grade conventional oil.

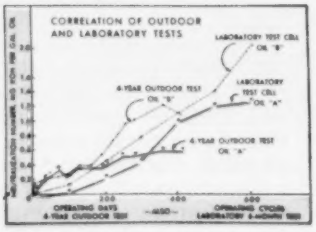

CORRELATION OF OUTDOOR AND LABORATORY TESTS
LABORATORY TEST CELL OIL "B"
4-YEAR OUTDOOR TEST OIL "B"
LABORATORY TEST CELL OIL "A"
4-YEAR OUTDOOR TEST OIL "A"
OPERATING DAYS 4-YEAR OUTDOOR TEST
—AND—
OPERATING CYCLES LABORATORY 6-MONTH TEST

FIGURE 7—Typical curves showing the close correlation between the 4-year outdoor tests and the laboratory tests on two oils. This close correlation prevailed throughout on the various oils tested and in the wide variety of tests made.

FIGURE 3—Laboratory test coil after the equivalent of about 18 years service using a good grade of conventional oil. Notice the heavy sludge deposits, which have clogged oil passages, causing higher temperatures, deterioration of insulation, and lower overload capacity.

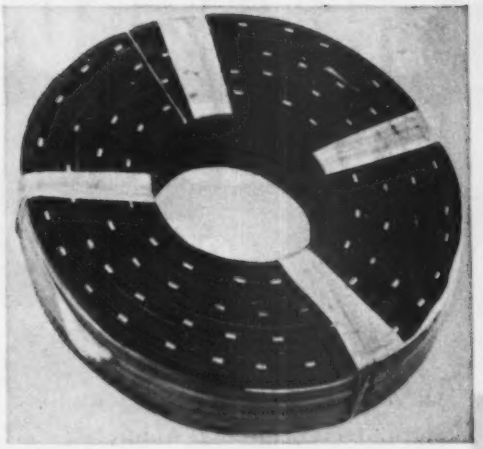


FIGURE 4—Here is an identical coil, after operating for the same period of time under the same conditions except that the oil was ORTO. Acid and sludge formation has been prevented; oil passages are clear; initial overload capacity and impulse-strength have been maintained.

FIGURE 5—Outdoor tests started some years ago were used as a basis for developing accelerated laboratory tests. These outdoor tests were closely checked against other long time tests run by oil companies and utility companies, and were correlated with laboratory procedure.

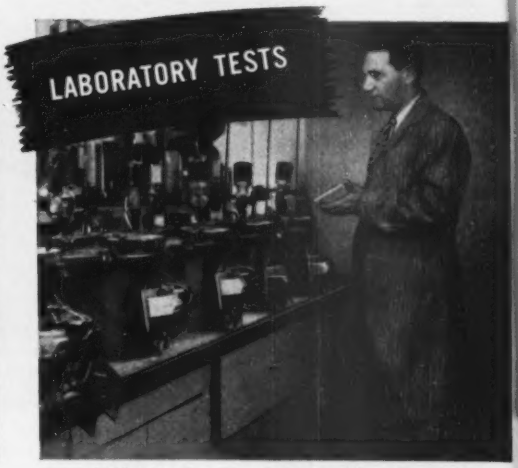


FIGURE 6—Laboratory equipment in which conventional and inhibited oils were tested under closely controlled conditions. The laboratory test permitted precise recording of acid and sludge formation and of deterioration of insulation, wire, and other parts of the transformer.

Look at the facts! Get details on L-M Round-Wound Transformers

L-M Round-Wound transformers consist of a wound core, with round coils wound directly onto the core, which therefore is not cut or unwound, and air gaps are not introduced.

Because of the design and the long, round coils, the transformers offer better regulation, high short time overload capacity, high impulse level and high short circuit strength, low exciting current, and better loss ratios. And they are filled with ORTO, L-M's outstanding Oxidation Resistant Transformer Oil!

Get the facts from the L-M Field Engineer, or write Mr. Zwelling at the Transformer Division, Line Material Company, Zanesville, Ohio (a McGraw Electric Company Division).

LINE MATERIAL
Transformers

LM ORTO

85

Complete Coordinated Equipment for Distribution Today

THE INDUSTRY'S FIRST STANDARDIZED "FAMILY"

of 5 KV Cutouts with interchangeable doors!

50 and 100 ampere cutouts, each with

new PND standard duty non-indicating doors

PVD standard duty indicating doors

PHD heavy duty non-indicating doors

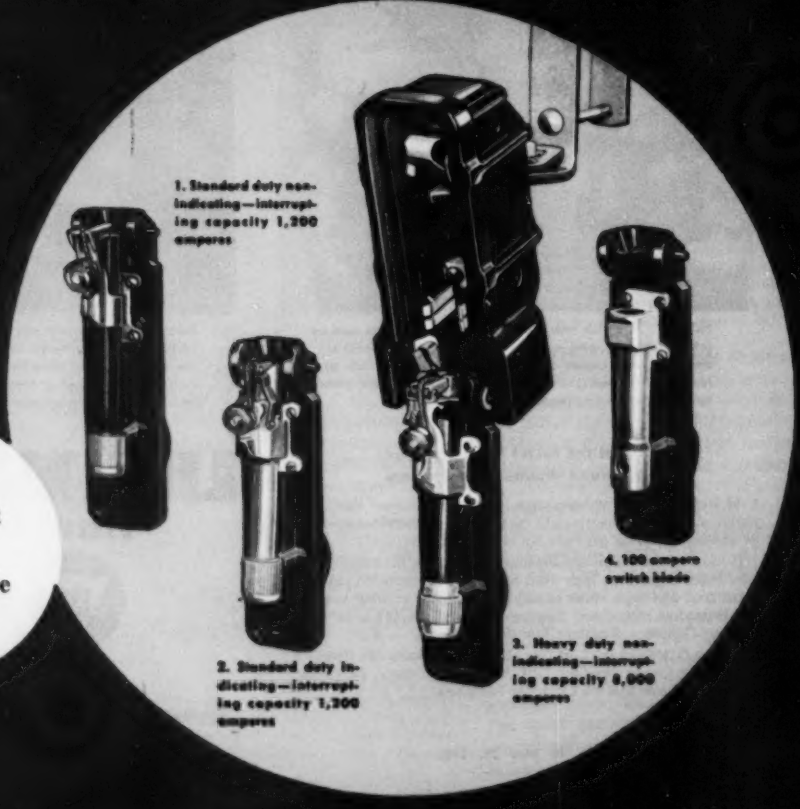
100 and 200 ampere switch blade doors

L-M, leading manufacturer of distribution cutouts, presents the first fuse cutout family offering complete interchangeability. 50 and 100 ampere boxes are offered, each taking care of four types of services.

Now—buy one box, with the doors you need for your present services. As operating requirements change, simply unhook the present door and hook on a new one. It's a 6-second job!

This new family saves space, time, and money in warehousing, installation, and operation. Safer, too! The lineman can remove the door completely, re-fuse, and replace it, all with the *switch stick*. When door is open, all door parts are dead.

Get the Whole Story. Ask the L-M Field Engineer, or write Line Material Company, Milwaukee 1, Wis. (a McGraw Electric Company Division).


1. Standard duty non-indicating—interrupting capacity 1,200 amperes
2. Standard duty indicating—interrupting capacity 1,200 amperes
3. Heavy duty non-indicating—interrupting capacity 8,000 amperes
4. 100 ampere switch blade

50
ampere cutout with four interchangeable doors

L-M's New 5 kv "first family"

RATING	INTERCHANGEABLE DOORS AVAILABLE	INTERRUPTING CAPACITIES RMS AMPERES 2.5 kv	5 kv
50 AMPERES	1. "PND" standard duty, non-indicating	1,200 amperes	1,200 amperes
	2. "PVD" standard duty, indicating	1,200	1,200
	3. "PHD" heavy duty, non-indicating	8,000	5,000
	4. Switch Blade	100 amperes continuous current rating	
100 AMPERES	5. "PND" standard duty, non-indicating	3,000	3,000
	6. "PVD" standard duty, indicating	3,000	3,000
	7. "PHD" heavy duty, non-indicating	14,000	10,000
	8. Switch Blade	200 amperes continuous current rating	

"PVD," "PND," and "PHD" are L-M trademarks.

78

LINE MATERIAL
fuse cutouts

Complete Coordinated Equipment for Distribution Today

Also in 7.5 kv sizes

A 7.5 kv family is also available, with 50 and 100 ampere cutouts, each with four interchangeable doors. Doors can be bought separately.

UTILITY DATA SHOWS OUTSTANDING 99.94% PERFORMANCE RECORD FOR L-M VALVE TYPE LIGHTNING ARRESTERS

Six-year performance records of a large midwestern utility show that L-M valve type lightning arresters have an exceptionally good operating record. With a total of 41,175 service years, only 23 L-M arresters had Isolator* operations while in service—there was only one instance of radio interference from L-M arresters—and of 613 arresters brought into the shop for electrical testing, not one was found faulty.

Here are the records for the years 1945 through 1950.

Year	Arresters in Service	Isolator Operations in Service	Number Tested	Failed in Test
1945	3,286	5	0	0
1946	4,322	2	11	0
1947	6,020	2	137	0
1948	7,469	4	118	0
1949	8,686	3	186	0
1950	11,392	7	161	0
Total Arrester Service Years	41,175	23	613	0

23 ÷ 41,175 = .056% failure rate

This substantiates the claims that L-M engineers have always been able to make—that L-M arresters give remarkable protection, excellent performance, and long life with unchanging characteristics.

Testing Greatly Simplified. The Pyrex® glass housing of L-M valve type arresters allows you to "test by sight." You don't have to make an electrical test of every single arrester. Just look at the spark gap—any irregularities can be detected by sight. If the Isolator* is intact you know the valve element is okay. That's all there is to it—if you use L-M Pyrex-housed valve type lightning arresters.

Get Complete Details. For complete information on L-M Lightning Arresters, and details of visual test methods, ask the L-M Field Engineer, or write Line Material Co., Milwaukee 1, Wis. (a McGraw Electric Company Division).

LM

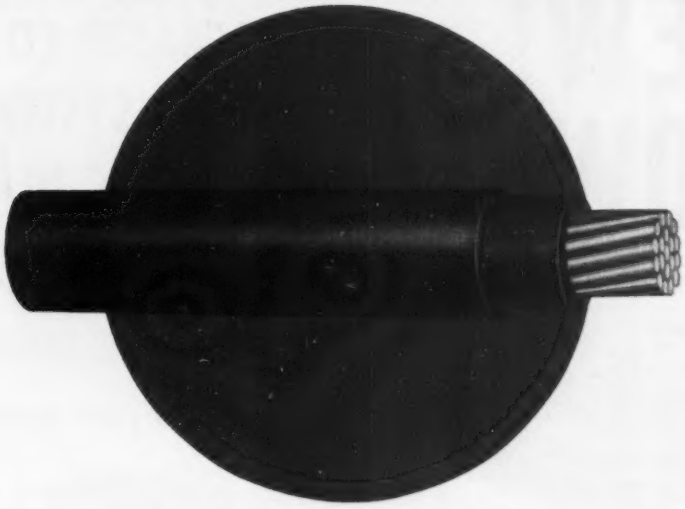
LINE MATERIAL

Lightning Arresters

Complete Coordinated Equipment for Distribution Today

*L-M's "ISOLATOR," watchdog of arrester trouble, gives positive assurance against grounding feeders through damaged arresters, by disconnecting the ground lead from the arrester. (As shown in the operating company records above, in 41,175 arrester-years there were 23 isolator operations, which provided this disconnecting service.)

SIGNAL AND CONTROL WIRING • SHOP WIRING • REWIRING



SIMPLEX ANHYDROPRENE WIRES

For wiring installations where the use of ducts is required, you'll find ANHYDROPRENE Wires hard to beat for long, trouble-free service and economical operation. The reason? ANHYDROPRENE'S Anhydrex insulation and thin — but tough — neoprene jacket are more than equal to the hazards that make short work of ordinary wires. In addition, they contribute to low-cost installation and maintenance.

Take a look below at the features they provide and you'll see what we mean. Specify ANHYDROPRENE for your future wiring jobs and you'll see what **they** mean in more-satisfactory performance and in dollars saved.

- Flexibility
- Light Weight and Small Diameter
- Unexcelled Resistance to Water and Moisture
- Protection against Oils, Grease and Flame
- Resistance to Acids, Alkalies and Corrosive Chemicals
- Elimination of Braids that Fray and Rot
- Easy Pulling through Ducts without Use of Lubricants
- Molded or Stamped Markings for Instant Identification

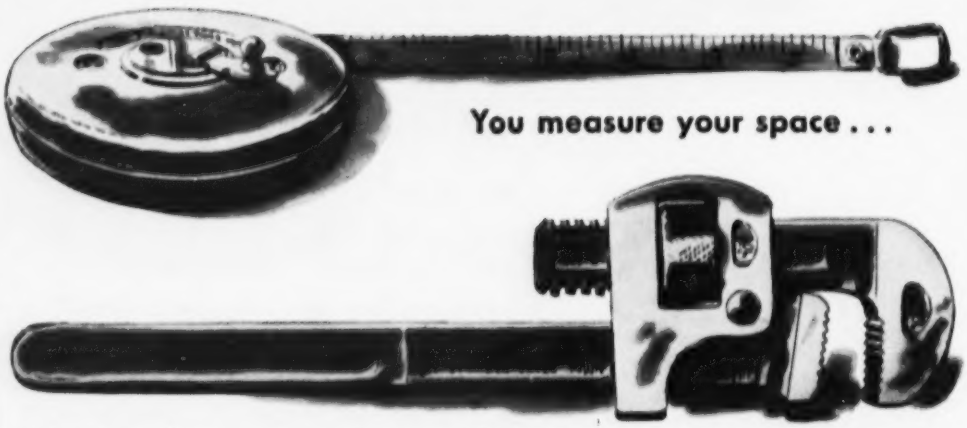
For more-complete information write for Bulletin 115.

Simplex - WIRES & CABLES

SIMPLEX WIRE & CABLE CO.
79 SIDNEY STREET,
CAMBRIDGE 39, MASS.

NEW! NOW!

SIX PRE-PACKAGED CO_2 FIRE EXTINGUISHING SYSTEMS TO FIT YOUR SPECIFIC NEEDS!



anybody who can cut pipe can install them

Here's inexpensive built-in carbon dioxide fire protection against normal flammable liquid and similar industrial hazards.

The new Kidde Standard Pak is a ready-made, pre-engineered fire extinguishing "package" for volumes up to 6,000 cubic feet. Anyone who can cut pipe can install it. Each kit contains dependable Kidde rate-of-rise heat detectors, efficient Kidde Multi-jet nozzles, and automatic discharge heads. Paks are supplied with or without pipe and fittings. Optional accessories include pressure trips and switches, remote controls, sirens, gongs.

A choice of six sizes assures you of the right package for your particular requirements. For complete information send us coupon below.

Please send me details on the New Kidde Packaged Fire Extinguishing System

NAME _____

FIRM NAME _____

ADDRESS _____

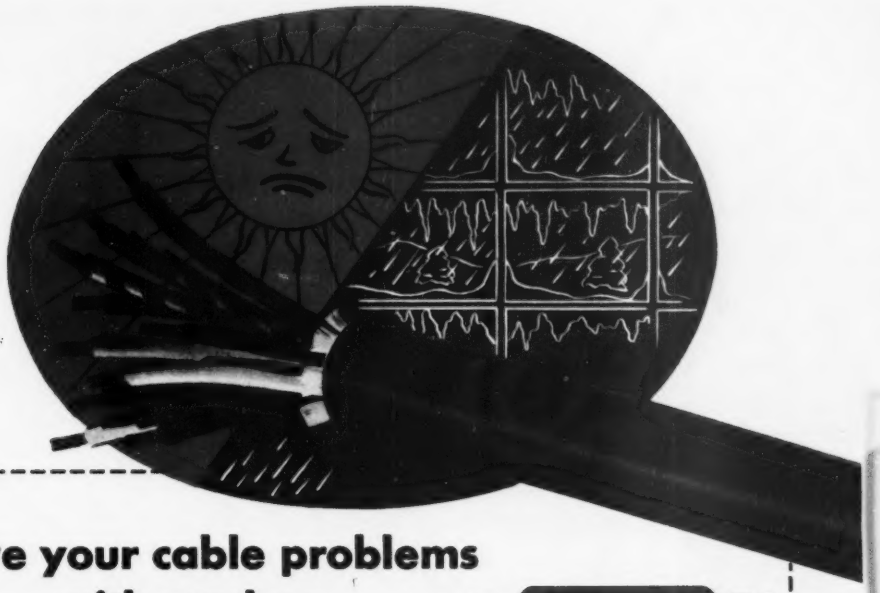
CITY _____ ZONE _____ STATE _____

Kidde

Walter Kidde & Company, Inc.

538 Main Street, Belleville 9, N. J.

Walter Kidde & Company of Canada, Ltd., Montreal, P. Q.



solve your cable problems with modern, all-plastic, all-weather Ankoseal®

Supervisory Control Cable
Pilot Cable • Relay Cable
Station Control Cable
Meter Cable
for Overhead or Direct Burial Use

Ansonia Ankoseal, a remarkable, thermoplastically insulated and jacketed cable, is outstanding for dielectric strength, flexibility and other important factors. It possesses notable flame and oil resisting qualities and is highly resistant to acids, alkalies, sunlight, moisture and most solvents. Because of its low dielectric loss in high-frequency transmission, Ansonia Ankoseal is well adapted to both radio and audio fields.

Increasing numbers of alert utility engineers are using Ankoseal for Supervisory Control Cable, Pilot and Relay Cable, Station Control Cable and Meter Cable. They consider better service records, low cost of installation and maintenance, and lesser replacement frequency of utmost importance.

Write us today about your cable needs.

THE ANSONIA ELECTRICAL COMPANY
SUBSIDIARY OF NOMA ELECTRIC CORPORATION
ANSONIA, CONNECTICUT

"BROAD-JUMPING" FURTHER

THAN ANYONE BEFORE, JESSE OWENS, AMERICAN, SET A WORLD'S RECORD IN MAY, 1935, WITH A SENSATIONAL LEAP OF 26 FEET, 8¼ INCHES.

JENKINS

Gold Seal Tape

GOES FURTHER, TOO...

GUARANTEED FOOTAGE
You get full measure with every roll. Tapes up tight and snug to the last inch.

NO WASTE
All Gold Seal Friction Tape tears evenly, does not ravel, molds to uneven surfaces.

HIGH DIELECTRIC
Less Gold Seal Tape needed per job. No pinholes; one tape thickness insulates.

LASTING "TACK"
Gold Seal sticks to the job under toughest conditions of cold and moisture.

EASY HANDLING
Gold Seal does not peel, dry out or smear the hands in hottest weather.

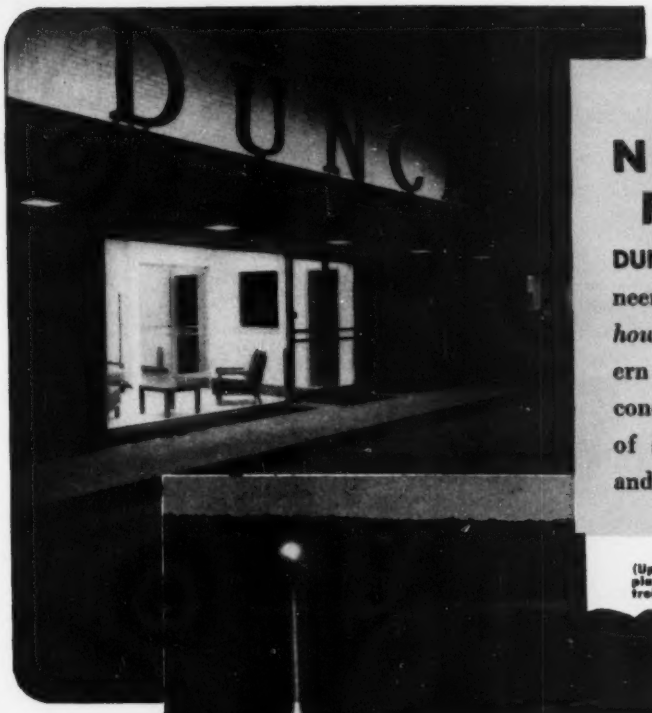
SPEEDS THE JOB
Linemen and electricians prefer Gold Seal Tape. It saves time and trouble.

IT'S YOUR BEST BUY FOR PLANT SUPPLY
Specify Gold Seal Tape and save.

FRICTION AND RUBBER TAPES
In either 10-roll cartons or single rolls. Every roll sealed in cellophane, stays fresh. Jenkins Bros., (Rubber Division), 100 Park Ave., New York 17.

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM and Federal Specifications.

A PRODUCT OF JENKINS BROS. . . . MAKERS OF FAMOUS JENKINS VALVES



To serve you

NEW PLANT FACILITIES

DUNCAN'S fifty years of engineering and production *know how*—now operating in modern facilities, under controlled conditions—is your guarantee of sound watthour meters and metering equipment.

(Upper left) Main entrance to the new Duncan plant . . . completely air-conditioned . . . controlled humidity. Construction by The Austin Co.

DUNC

1901 FIFTY YEARS OF SERVICE 1951

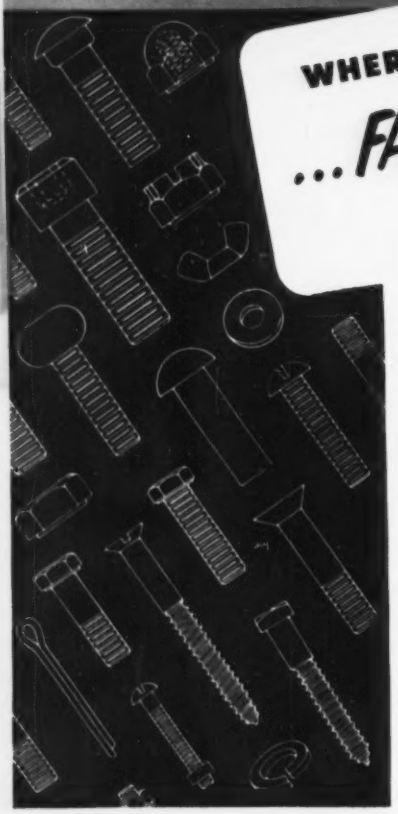
Watthour Meters • Demand Meters • Sockets
Heavy Duty Mounting Devices
Instrument Transformers

(Above) New Duncan plant . . . Aerial view looking toward Wabash Valley.

Engineering and drafting facilities . . . constantly working to meet industry requirements.

Manufacturing Area . . . high level of illumination . . . precision equipment . . . cleanliness, a must.

DUNCAN ELECTRIC MFG. CO. LAFAYETTE, INDIANA



WHERE CORROSION IS A PROBLEM

...FASTENINGS by HARPER

OFFER THE SOLUTION

Rain—snow—ice! Baking summer sun—bitter winter cold! Stress corrosion—electrolysis! These are all conditions that fastenings used by public utilities must meet.

Harper specializes in fastenings of alloys that will solve tough corrosion problems. Bolts—nuts—screws—rivets—studs—washers—cotter pins of brass, naval bronze, silicon bronze, Monel, nickel, stainless steel, aluminum.

Back of this company are 29 years of experience in meeting and solving tough fastening problems. Today, Harper is the largest company devoted exclusively to the manufacture of fastenings of non-ferrous metals and stainless steel. Harper engineers and metallurgists are ready to assist you in the solution of any fastening problems you may face. For better fastenings, call The H. M. Harper Company, 8205 Lehigh Ave., Morton Grove, Illinois.

There is a Harper distributor near you with stocks of fastenings ready to fill your order. Call him for prompt service.

HARPER

EVERLASTING FASTENINGS

Specialists in all non-corrosive metals

Completion of This R&S *Built*
NATURAL GAS DEHYDRATION CONTROL PANEL

. . . represents a 4-way achievement of coordinated planning!

OAKFORD, huge storage operation owned jointly by New York State Natural Gas Corporation and Texas Eastern Transmission Corporation, is now going into operation to bring an increased volume of natural gas to consumers throughout the area depicted here and to other distribution areas extending eastward to the coast.

Ford, Bacon & Davis, Inc., well-known engineering and construction specialists, was selected to design and build the big compressor station at Delmont, Pa. The appointment is typical of the outstanding services coordinated by the owners to assure completion of the project.

When the Oakford compressing station is completed, it will be one of the world's largest, with a capacity of 30,000 H.P. One of its principal functions will be the dehydration of natural gas with a maximum flow of 400MMcf per day to a dew point of 0° or less at a pressure range of 400 to 850 psig, through a closed cycle process developed by F. B. & D. engineers. To provide automatic control of the dehydration cycles, Russell & Stoll, in collaboration with Ford, Bacon & Davis, designed and built the colorful control panel featured here.

THE PANEL IS BUILT BY R&S

Russell & Stoll custom built this natural gas dehydration control panel throughout. R & S explosion-proof enclosures and components were used, along with R & S Unilarms, pilot lights and push button stations, terminal boxes, fittings and other R & S equipment for Class I, Group D hazardous locations. The control panel was then sealed and tested by R & S and shipped as a single unit direct to Delmont, Pa., ready for installation.

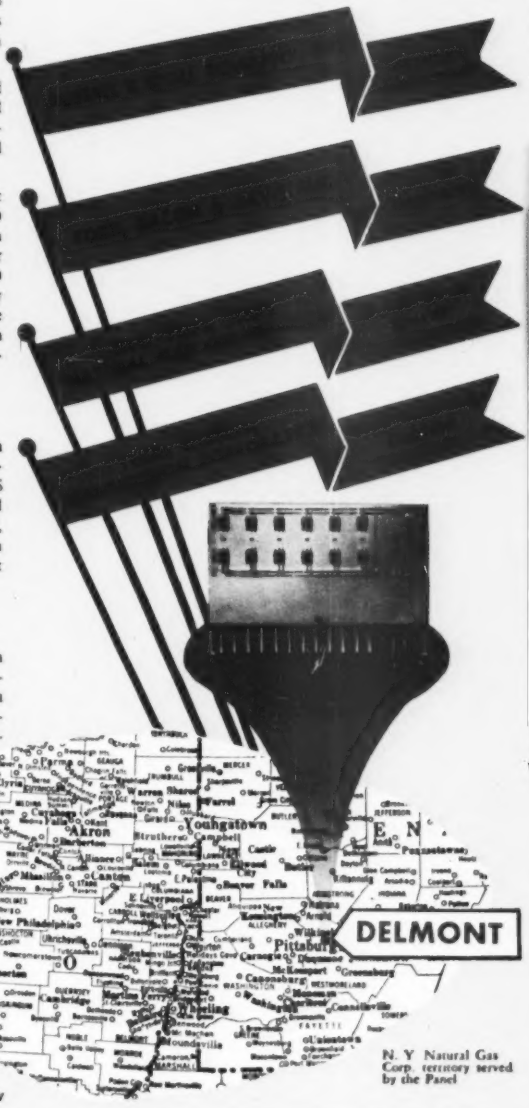
HOW THE PANEL WORKS

Basically, this control panel acts as a nerve and brain center of the gas dehydration process. By remote automatic control, it actuates 37 reversing starters mounted on six R & S panels which are located at the pipe line catwalks near the towers. These six panels control the opening and closing sequence of the motor operated valves on a predetermined operating cycle.

On the multi-colored face of the control room panel, you will note six symbolic towers. Each has its own outgoing conduits, as shown at the bottom of the panel, forming the interwiring connections to the valve motors and motor starter panels. Each has its grouping of pilot lights, which by their color and location when illuminated, indicate the operation then taking place.

The colored flow lines . . . the graphic outline of the compressor equipment . . . and the illuminated pilot lights of a specific cycle . . . all reveal the opening and closing sequence of the 37 motor valves and the flow changes of the gases through the towers. The drying, heating or cooling cycles are designated by the yellow, red and blue flow lines respectively.

A complete cycle of operation is four hours of drying, two hours of heating and two hours of cooling reactivation, in continuous sequence. At any time, four towers are being used for drying, one tower for heating and one tower for cooling.

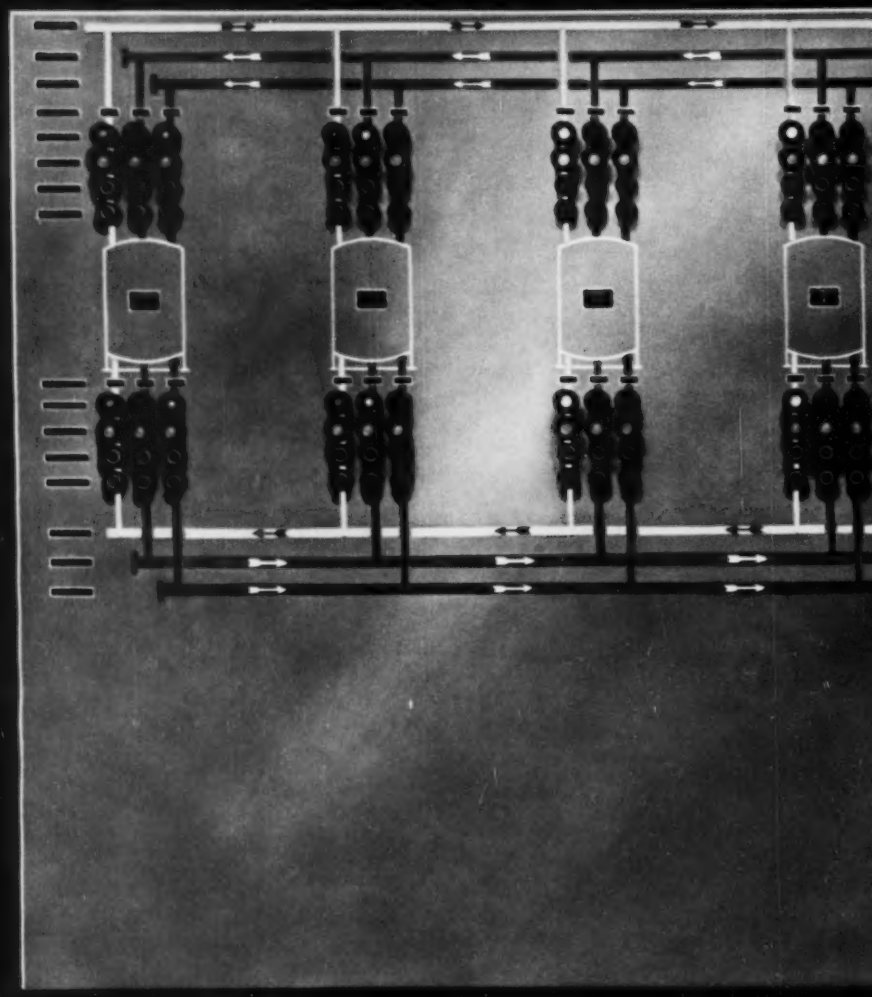


N. Y. Natural Gas Corp. territory served by the Panel

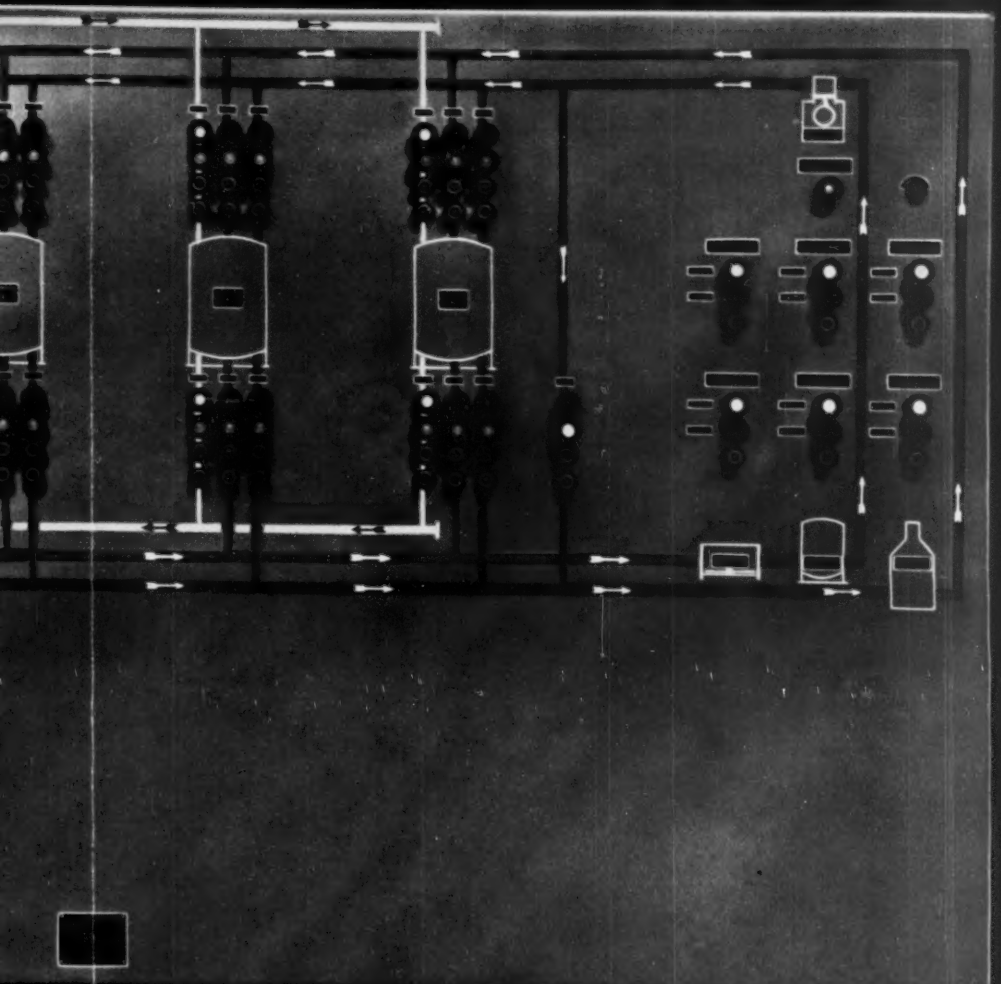
The back page of this insert shows the manner in which R & S equipment and component units were installed on the rear side of the panel.

LIFT UP

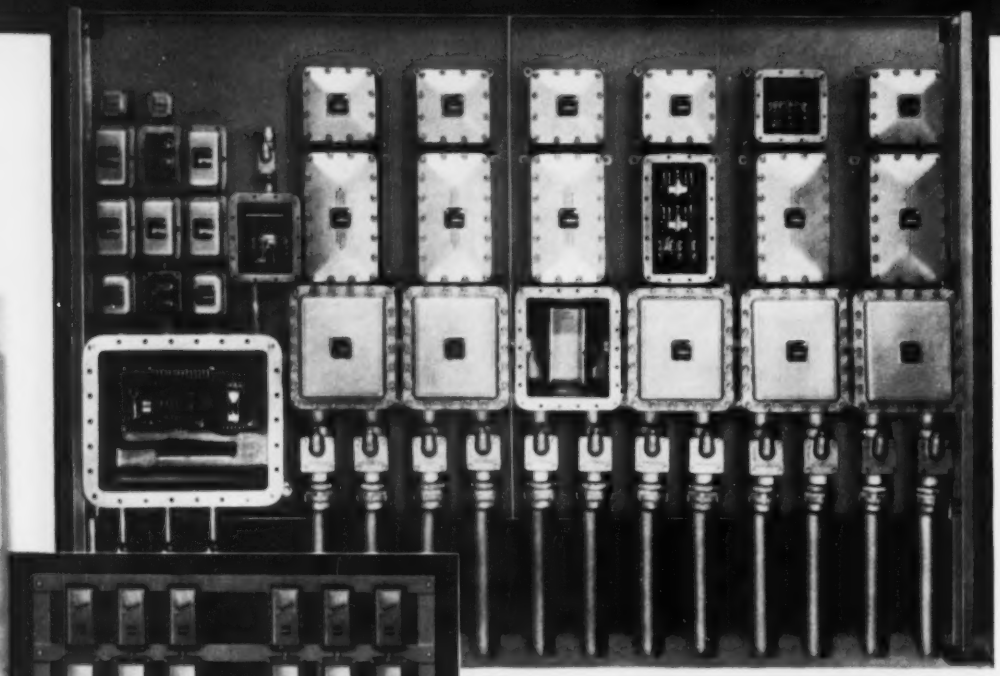
R & S Built *Natural Gas*

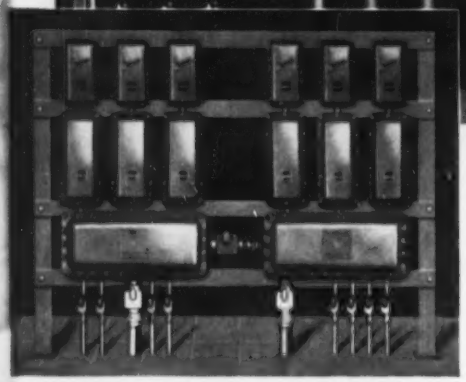


Gas Dehydration Control Panel



R&S BUILT





Six R & S custom built motor starter panels, identical to the one shown here, mount 37 across-the-line reversing starters and circuit breakers to control the opening and closing operating sequence of the motor operated valves. These panels are all located on the pipe line and catwalks near the towers of the Oakford compressing station and are interwired with the natural gas dehydration control room panel.

50 ANNIVERSARY 1902-1952

This is the "working side" of the natural gas dehydration control panel Russell & Stoll custom built for the Oakford storage operation. Note the efficient functional group arrangement of all the R & S enclosures and components applied within the confines of the panel space.

The illustration provides impressive testimony to the kind of rugged quality and precision manufacture R & S builds into hundreds of panels of every size and type, every year. Also, it typifies the variety of uses for which the complete line of R & S electrical specialties are specified today. And it emphasizes the widening scope of services we are rendering to the petroleum, chemical, utility and other fields of industry in this Golden Anniversary Year of the founding of the Russell & Stoll Company.

But more than that, it proves the *adaptability* of the Russell & Stoll organization to produce any kind of panel or panelboard for any kind of hazardous location. Moreover, it's an adaptability that can utilize many standard R & S equipment units as "packaged" components of standard or custom built panels — a faster, easier construction method that eliminates the delays of costly "special design" equipment.

If you are concerned with the proper application of explosion-proof equipment to eliminate dangers to life and property in the wiring systems of your hazardous locations, why not investigate the R & S individualized approach to specific problems. Write us today.

RUSSELL & STOLL COMPANY, INC. • 125 BARCLAY STREET, NEW YORK 7, N.Y. G-1

RUSSELL & STOLL

This *NEW INSTRUMENT* Offers Greater Convenience in Field Use

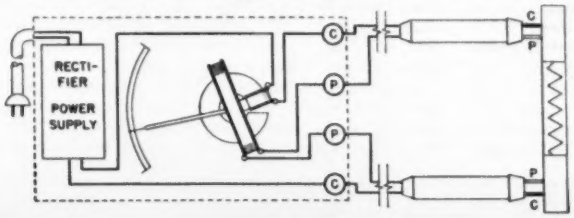
MEGGER® LOW RESISTANCE OHMMETER

This most recent addition to the Megger family of electrical resistance measuring instruments is a general purpose type with self-contained power supply. The set is available in two models, both having the same ranges of 0 to 1000 and 0 to 10,000 microhms. Model 1B carries batteries and Model 1R has a built-in rectifier which plugs into any ordinary lighting circuit outlet. Ample space is provided for the storage of all necessary leads and prods in a compartment of the same case.

The complete unit, with either battery or rectifier weighs only about 19 pounds. It is, therefore, easily portable and convenient to use in the field.

Write for Bulletin 24-46 EW which describes these new instruments completely.

Schematic diagram of electrical connections for the Megger Low Resistance Ohmmeter



JAMES G. BIDDLE CO.

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

BIDDLE *Instrument News*

"CABLE-FAULT LOCATING PRACTICES IN PHILADELPHIA"

That is the title of an article which appeared in a recent issue of Electric Light and Power Magazine. It was written by R. S. Diggs, Assistant Superintendent, Service Maintenance Section, Philadelphia Division, Electric Transmission and Distribution Department of the Philadelphia Electric Company.

Mr. Diggs discusses the three methods of locating cable faults used on his company's underground power systems, the a-c method, the thyratron, and the impulse method.

We have obtained a limited supply of these reprints and will be glad to supply them to interested individuals so long as the supply lasts. Check Bulletin 65 P1 EW on the coupon below.

USERS FIND BIDDLE TTR SETS INDISPENSABLE

There have been a lot of mighty fine things said about our Transformer Turn Ratio Test Set in the two years we have been producing them. But nothing we have heard compares with the comments we have been hearing lately.

Since the announcement of Model 3 we have had requests for modification of several earlier models. It is gratifying to receive comments like:

"We hope that the change-over will not require too much time as this instrument is in daily use on our test floor." and:

"Our instrument is used constantly by the testing department and is such a timesaver that we want to have it back in service as soon as possible."

We would like to quote all the things that have been said about this unique instrument but space does not permit. We urge those who have not investigated the TTR Set to do so by writing for Bulletin 55 EW which describes it in full.

James G. Biddle Co.
1316 Arch St., Philadelphia 7, Pa.

Gentlemen:
Please send me items checked:

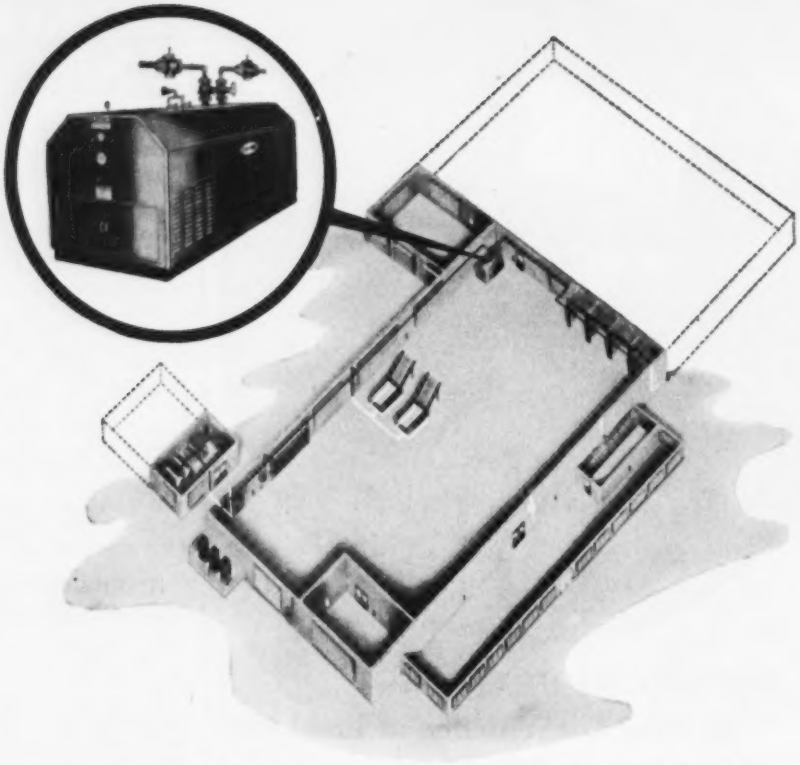
☐ 24-46 EW ☐ 65 P1 EW ☐ 55 EW

NAME

JOB FUNCTION

COMPANY

ADDRESS



EXPANSIBLE FIRESAFETY

from a single LOW PRESSURE CARBON DIOXIDE storage tank

When expanding your plant, you can't afford to wait for additional fire protection...you need the proper amount at once. However today, material priority regulations slow you up considerably...these delays hold back vital production and resulting revenue. Install a C-O-TWO Low Pressure Carbon Dioxide Type Fire Extinguishing System in your plant now and new construction to come will be firesafe from the start.

With a C-O-TWO Low Pressure Carbon Dioxide Type Fire Extinguishing System, simple piping, running from one centrally located storage tank, instantly transports clean, non-damaging, non-conducting carbon dioxide anywhere in the plant area...to flammable liquids, electrical equipment, storage spaces, manufacturing processes and record vaults. Fire at any protected location is extinguished in seconds with an absolute minimum of expense and interruption.

Future plant expansion is quickly and economically provided for by initially installing an oversized low pressure carbon dioxide storage tank...capacities range from one to fifty tons. Discharge facilities can be either manual mechanical, manual electric, automatic mechanical, automatic electric or a combination of these...all are easily extensible at a later date.

Don't take chances with future delayed installations; secure the benefits of highly efficient fire protection engineering today...our extensive experience over the years is at your disposal without obligation. Get the facts now!

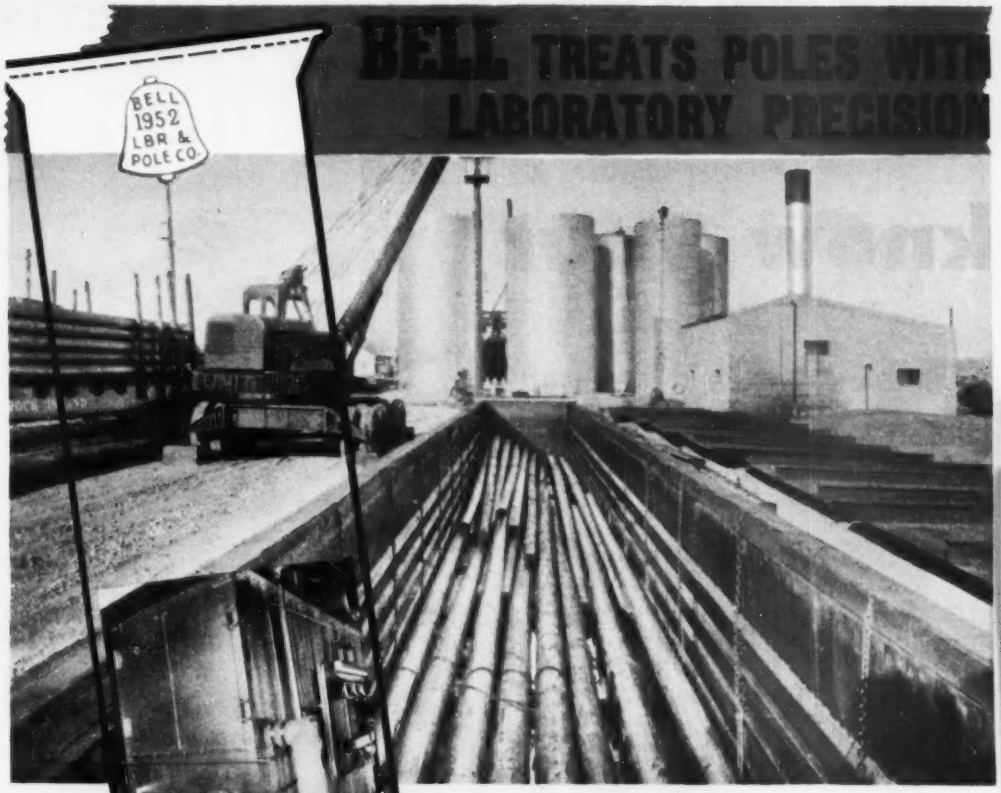
C-O-TWO

C-O-TWO FIRE EQUIPMENT COMPANY
NEWARK 1 • NEW JERSEY
Sales and Service in the Principal Cities of United States and Canada
Affiliated with Pyrene Manufacturing Company

MANUFACTURERS OF APPROVED FIRE PROTECTION EQUIPMENT

Squeez-Grip Carbon Dioxide Type Fire Extinguishers • Dry Chemical Type Fire Extinguishers • Built-In Smoke and Heat Fire Detecting Systems
Built-In High Pressure and Low Pressure Carbon Dioxide Type Fire Extinguishing Systems

BELL TREATS POLES WITH LABORATORY PRECISION



Penta treated fir poles, unshaved—full length treating tank

Accurately controlled temperatures of heat transfer oil for maximum penetration and retention of preservative in Western Pole species.

The BELL organization, in keeping with its Progressive Policy of advancement in facilities and methods, again makes a notable forward step with a new type of heating system.

Thermostatic control is now provided in all phases of the treating procedure. This specially developed BELL system, in adding new advantages and highest quality results, operates in combination with BELL's own "constant circulation of preservative" method.

Installed at BELL's Minnesota Transfer Plant, this system employs heat transfer oil as the heating medium. It provides a better distribution of temperatures throughout working preservative solutions, cleaner treated poles, and full, even penetration.

BELL Poles—known for their excellence of appearance and for quality that assures maximum service life, now set a new high standard in all around quality.

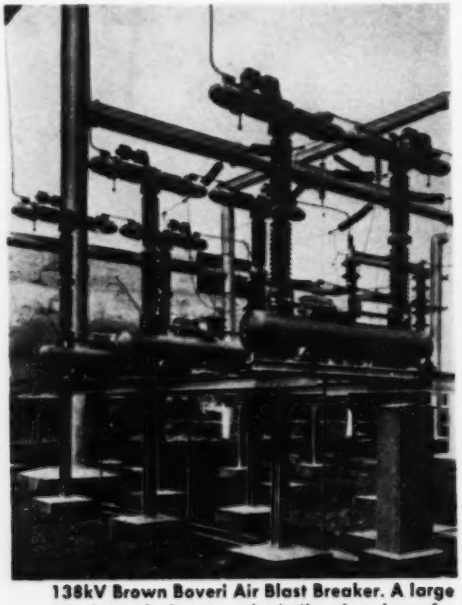
BELL affords a dependable source for transmission and distribution poles—get the benefits that BELL's new laboratory precision treatment makes possible.

BELL LUMBER & POLE CO.

Minneapolis, Minn.

WHEN IT COMES TO DEPENDABLE ELECTRICAL PROTECTION FOR DISTRIBUTION SYSTEMS, IT PAYS TO...

know your P's and Q's



138kV Brown Boveri Air Blast Breaker. A large number of these and similar breakers for voltage up to 230 kV are on order and in service in both the U. S. A. and in Canada.

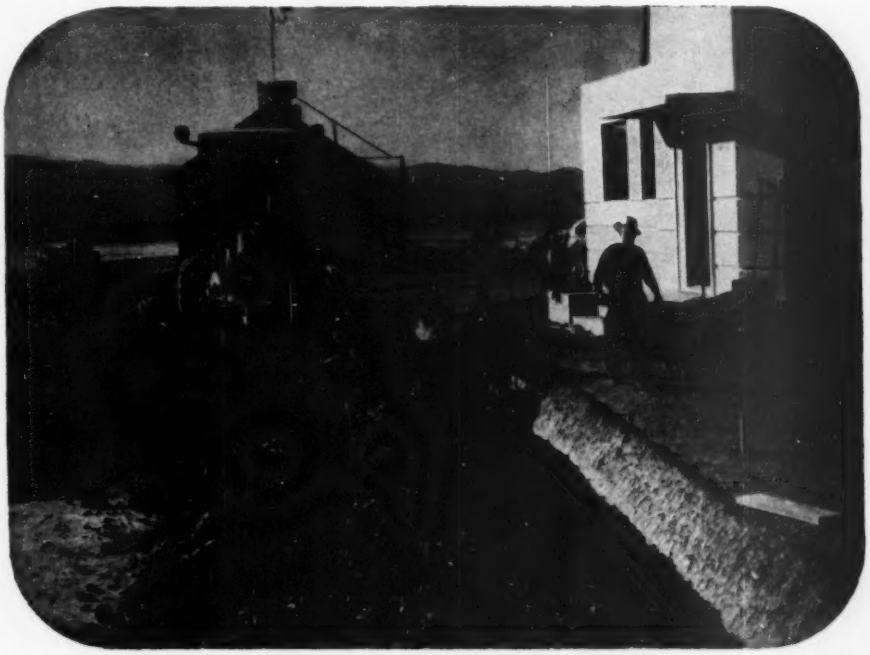
Performance and Quality, price and delivery, are the real reasons why Brown Boveri Outdoor and Indoor Air Blast Breakers should be installed in modern distribution systems. WRITE FOR DATA.

BROWN BOVERI

BUY BROWN BOVERI AIR BLAST BREAKERS
...for Performance and Quality!

BROWN BOVERI CORPORATION
19 RECTOR STREET, NEW YORK 6, N. Y.

PARKWAY CABLE



Save the cost of duct systems!...with the most dependable Parkway Cable you can buy!

ROEBLING'S research staff is continually working at the job of product development. Our manufacturing facilities and techniques are constantly improved. That's why our Parkway Cable for distribution and general power supply circuits is today even more dependable than ever before.

Roebling Parkway Cable saves money right from the start because it is buried directly in a shallow, low-cost trench. It is made in single and multiple conductor – solid or stranded – in a range from 600 to 5,000 volts . . . furnished with metallic armor or a non-metallic *Roeprene* sheath, depending on the physical protection required. Types that pass all C.A.A. requirements for Specification No. L-824 for airport lighting are also available.

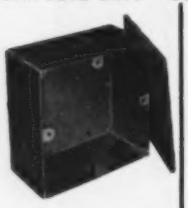
Large quantities of Roebling's full line of electrical wires and cables are needed in the rearmament program. We and our distributors will do everything possible, however, to meet your requirements. John A. Roebling's Sons Company, Trenton 2, N. J.

ROEBLING

ATLANTA, 934 AVON AVE • BOSTON, 51 SLEEPER ST & 5 PITTSBURGH ST • CHICAGO, 5525 W. ROOSEVELT RD • CINCINNATI, 3253 FREDONIA AVE • CLEVELAND, 701 ST. CLAIR AVE, N. E. • DENVER, 4801 JACKSON ST • DETROIT, 915 FISHER BLDG • HOUSTON, 6216 NAVIGATION BLVD • LOS ANGELES, 5340 E. HARBOR ST & 120 S. HEWITT ST • NEW YORK, 19 RECTOR ST • ODESSA, TEXAS, 1920 E. 2ND ST • PHILADELPHIA, 230 VINE ST • PITTSBURGH 1301 CLARK BLDG • ROCHESTER, 1 FLINT ST • SAN FRANCISCO, 1740 17TH ST • SEATTLE, 900 1ST AVE S. • ST. LOUIS, 2001 DELMAR BLVD • TULSA, 321 N. CHEYENNE ST • EXPORT SALES OFFICE, TRENTON 2, NEW JERSEY

O. Z. cast iron boxes

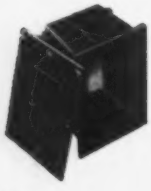
COMPLETE LINE • COMPLETE LINE • COMPLETE LINE COMPLETE LINE



TYPE YS
Unflanged junction box with cover. Flush or Surface mounting.

TYPE YW
Weatherproof pull box. Complete with one-piece rubber gasket and hinged cover; surface mounting.

TYPE YE
Explosive resisting junction box designed in accordance with Underwriter's Laboratory requirements. Cover and flange are accurately machined and correct bolt spacing provided. Flush or Surface mounting.



TYPE YF
Flanged watertight box with cover complete with rubber gasket. Flush or Surface mounting.

S214

When you specify O. Z. Cast Iron Boxes for industrial, railroad, airport, oil refinery and other heavy-load circuits, you specify the best. Cast from close-grained, grey iron, these sturdily constructed boxes are accurately machined to your requirements and then hot-dip galvanized to provide maximum corrosion resistance.

No matter what the operating condition . . . explosion resisting, watertight or weatherproof . . . you'll find a box to fit the job in O. Z.'s complete line. All boxes can be supplied with or without bosses or mounting lugs and are drilled for conduit entrances as required.

For detailed information on O. Z.'s Cast Iron Boxes as well as 150 other electrical fittings, write for our catalog.

- CAST IRON BOXES
- SOLDERLESS CONNECTORS
- CONDUIT FITTINGS
- CABLE TERMINATORS
- GROUNDING DEVICES
- POWER CONNECTORS

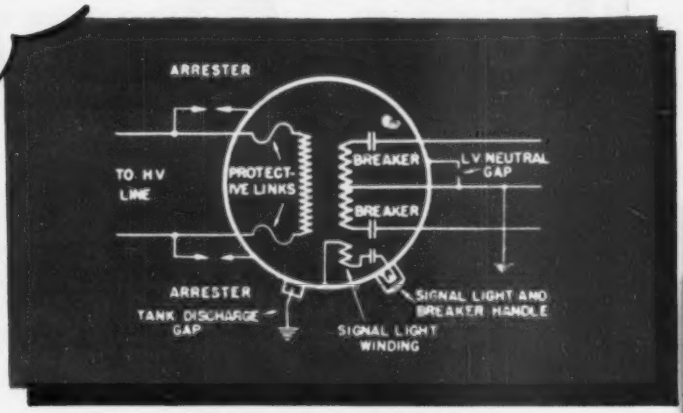
Buy O. Z. and you'll see why Engineers say,

"They're OK If They're O. Z."

O. Z. ELECTRICAL MANUFACTURING COMPANY, INC.

262 BOND STREET BROOKLYN 2, N. Y.

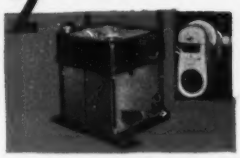
Here are 4 reasons why engineers say HiperCore CSP is better!



1 BUILT-IN ECONOMY!

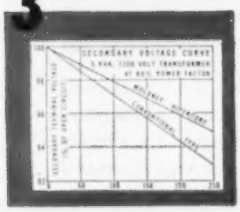
Lightning arresters, internal fuses and secondary circuit breakers integrally mounted, provide complete protection against lightning, short circuits or overloads. Installation costs are reduced and transformer burnouts become extreme rarities.

2 GREATER RELIABILITY!



Overload is automatically revealed by an indicator light. If the load becomes excessive, the secondary breaker automatically opens *before* serious damage occurs to the transformer insulation. Service is quickly and easily restored by means of a hook stick.

3 SUPERIOR PERFORMANCE!



HiperCore design produces a transformer with better voltage regulation and better all-round system performance. Its lower impedance means that secondary voltage fluctuations, due to sudden or intermittent load changes, are reduced. Secondary voltages may be maintained at a higher level resulting in improved performance of the connected load.

4 COMPACT DESIGN!

All Moloney Distribution Transformers, whether conventional or CSP, are of HiperCore Design which most effectively takes advantage of the high permeability of cold rolled, oriented grain silicon steel. This smaller, more efficient core-and-coil unit makes possible a much smaller and lighter transformer than any other method of construction. Compactness and lighter weight result in greater ease of handling, storing and installing.

Here are more reasons

- **Improved Short-Time Overload Capacity**
- **Surge-Proved Core-and-coil Design**
- **High Short Circuit Strength**
- **Low Temperature Gradient**
- **Positive Action Tap Changer**
- **Sealed Tank Construction**

MOLONEY ELECTRIC COMPANY

Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers Step Voltage Regulators • Unit Substations

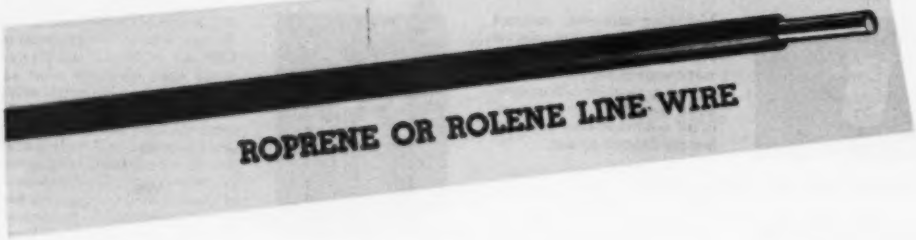
MOLONEY ELECTRIC = BETTER PERFORMANCE, GREATER RELIABILITY, LESS MAINTENANCE

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA

You get these advantages with

Rome Aluminum

ROPRENE SELF-SUPPORTING SERVICE DROP CABLE



ROPRENE OR ROLENE LINE WIRE

3 BIG REASONS...

Why you are bound to save money with Rome Aluminum Self-Supporting Service Drop Cable and Rome Aluminum Line Wire . . . lower purchase cost . . . lower installation costs . . . longer service life.

Lower purchase cost... Depending upon the service involved, aluminum conductors cost less today.

Lower installation costs... Aluminum's lighter weight means easier and cheaper handling . . . in many instances permits longer spans with fewer poles. The simplicity of Rome's Self-Supporting Cable construction means increased savings through cheaper hardware and ease of installation.

Longer service life... Aluminum has proved itself as a long-life conductor material. RoPrene (Neoprene) as well as RoLene (polyethylene) as either insulation or covering has exceptional resistance to sunlight, moisture, corrosive atmospheres and abrasion. With no braids to rot and festoon, replacement is minimized.

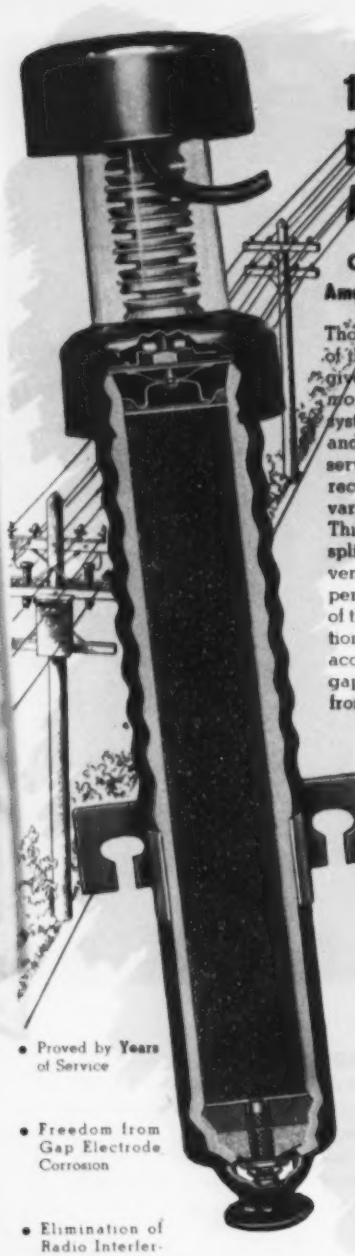
Rome Aluminum Self-Supporting Service Drop Cable is regularly supplied with two RoPrene (Neoprene) insulated power conductors of solid aluminum, spiralled around a bare neutral messenger of ACSR (aluminum conductor steel reinforced). This time-proven construction provides high strength, simplicity of installation.

Rome Aluminum Line Wire is available with covering of RoPrene (Neoprene) or RoLene (polyethylene) as specified. Here is low cost Line Wire having ease of handling, as well as long, non-festooning service life. Uniformly small diameters provide neater appearance, plus reduced wind and ice loading.

It Costs Less to Buy the Best

Rome ALUMINUM

ROME CABLE CORPORATION, ROME, N.Y., AND TORRANCE, CALIF.



16 Years' Operating Efficiency... Almost 100%!

Crystal Valve Arresters Establish Amazing Record of Efficient Protection

Thousands of Crystal Valve Arresters of the ventilated spark gap type have given unsurpassed performance *for more than 16 years* on distribution systems both here in the United States, and in foreign installations. Careful service checks indicate a performance record of almost 100% under a wide variety of service conditions.

This outstanding arrester provides split-second protection. The spark gap vents, an important design feature, permit movement of the air in and out of the spark gap housing, and circulation within the housing. This prevents accumulation of moisture, protects gap elements and housing interior from corrosion.

Other features include: glass housing for the gap structure on arresters that operate at the higher voltage ratings—inspection made easy, multiple arcing unit with smooth discharge surfaces, high speed operation. Oxidized silicon carbide valve element assures low IR voltage drop, high surge discharge capacity. Available in five voltage ratings.

Crystal Valve Lightning Arresters offer complete protection and service that lasts.

- Proved by **Years** of Service
- Freedom from Gap Electrode Corrosion
- Elimination of Radio Interference

Write Dept. 1709 today for new folder describing in detail Crystal Valve Ventilated Spark Gap Arresters. Ask for No. 433.

ELECTRIC SERVICE MANUFACTURING CO., PHILA. 32, PA.

CRYSTAL VALVE

LIGHTNING ARRESTERS

What Makes A Good Spark Gap Assembly?

by

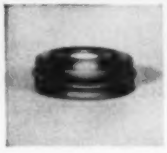
J. R. McFarlin, Vice President

ELECTRIC SERVICE MANUFACTURING CO.

Spark gap assemblies of valve type lightning arresters are vitally important elements of the arrester; they ordinarily consist of a series of individual gaps formed from electrodes separated by insulating spacers, and properly assembled on an insulated support; the number of individual gaps and their sparkover value is dependent on the voltage rating of the arrester; such assemblies may appear to one to be simple and ordinary structures but have you ever given thought to some of their technical aspects?

For instance, do you know why brass is ordinarily used for spark gap electrode? The reason dates back to 1892 when Alexander Wurts published results of his classic experiments on non-arcing metals for spark gap electrodes; Wurts found that the best non-arcing properties were found to exist in the metals covered by Group 2 of Mendeleff's "Periodic Arrangement of the Elements"—beryllium, magnesium, calcium, zinc, strontium cadmium, barium, mercury, radium; obviously zinc was the most practical. Zinc itself has too low a fusing point to be satisfactory as a gap element, so it was alloyed with copper, the alloy was found to be highly satisfactory and as a result, from about 1892 to the present day, practically all valve type arresters have had spark gap electrodes made of brass.

Many other factors enter into the design of efficient spark gap assemblies—zinc content of brass used, its hardness, shape of electrodes and discharge surfaces, accuracy of electrodes and spacers, inter-electrode capacitance, grading, sparkover characteristics—all of which are important in this element of the arrester.

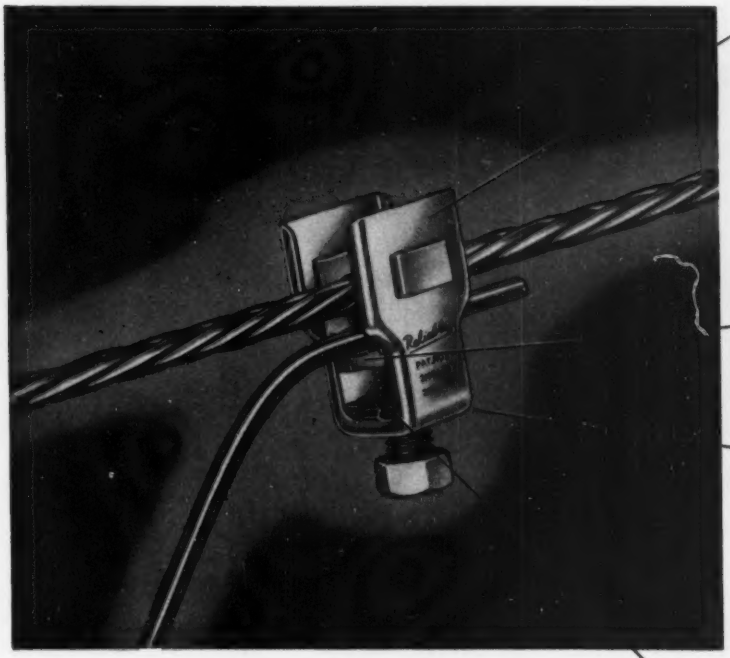


Why do Crystal Valve lightning arresters use the particular gap assemblies they do? Back in 1916 this Company designed a spark gap unit, many millions of which have been used in various types of arresters since that time. The electrodes were circular in shape and made of brass; the arcing surfaces were somewhat flattened and smooth; they were used as single gaps and in multi-gap assemblies; in 1916 electrode spacers and supports were made of molded plastic—since 1926 they have been made of steatite; in 1916 and to date manufacturing tolerances on all parts have been held to exceptionally close limits.

Since their development in 1916 considerable research has been done in attempts to improve the excellent characteristics of these electrodes and assemblies. Result? The spark gap structures used in Crystal Valve arresters of today are fundamentally the same as were used in arresters of our manufacture some 35 years ago and are one of the components responsible for the oustanding performance of these arresters over a period of some 26 years.

(Advertisement)

Accents on Accuracy



in Aluminum to Aluminum and
Aluminum to Copper Connections

FLIP-ON TAP CLAMPS

(over six million now in service)

Accurately gaged threads and spacers always work smoothly – snug-up tighter, then stay tight–while large bearing surfaces protect the conductors from damage. All parts are accurately heat treated. Their lighter construction of aluminum alloy reduces vibration fatigue. Where dissimilar conductors are used, thick aluminum spacers are copper faced for best protection against corrosion. Spacers accurately align conductors under screw pressure so that the joint gets the full benefit of direct (1:1 ratio) pressure. Reliable's accent on accuracy assures quick and easy installations – – – rugged, Reliable performance.

Reliable ELECTRIC COMPANY

3145 CARROLL AVENUE, CHICAGO 12, ILLINOIS

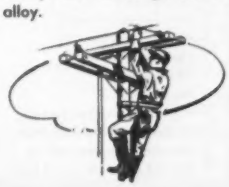
OVER 45 YEARS OF SERVICE TO THE UTILITIES

1. Precision dies and faultless equipment produce rugged body — wall slots are accurately parallel for easy, reliable pressure-clamping.

2. Exact manufacturing techniques assure these carefully engineered spacers give firm, reliable connections — without damaging conductors.

3. Nut is staked in body before tapping. Four full threads are continuous. Aligning fixture insures accuracy of direction. Pressure on conductors is directly under screw in opposite directions (ratio 1:1).

4. Accurately controlled electric furnaces bake long life and reliability into this tough aluminum alloy.



POWER-LINE CONNECTORS
AND
CONSTRUCTION SPECIALTIES

An important splice in progress on a 3/c, 500 MCM, 26,400 V shielded paper-lead feeder cable for Public Service Electric and Gas Company's new Warren Point Substation at Fairlawn, N. J.

PUBLIC SERVICE

Public Service Electric and Gas Company insures continuity of service with NATVAR Splicing Kits

Veteran splicers in the Underground Department like Natvar splicing kits, because they provide exactly the right number of rolls of v.c. tape cut to proper lengths and widths, and exact quantities of other materials required for the job. Engineers and foremen like the kits because they give close "quality control" of the splicing operation, with a minimum of waste and spoilage.

Public Service is working around the clock to provide adequate service for one of the fastest growing areas in the country. Long range planning demands that additional facilities to meet the increasing load be built on a permanent basis.

For this reason, extreme care is exercised in the selection of equipment and materials for the expansion program. Natvar splicing kits, made up in units for various sizes and types of cable, speed underground splicing because of their convenience and insure uninterrupted service because of the uniformly high quality of the materials.

All Natvar flexible insulations have excellent physical and electrical characteristics, and are dependably uniform, no matter where or when purchased. They are available either from your wholesaler's stock or direct from our own.

Natvar

Natvar Products

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Silicone coated Fiberglas
- Varnished papers
- Slot insulation
- Varnished tubing and sleeving
- Varnished identification markers
- Lacquered tubing and sleeving
- Extruded plastic tubing and tape
- Extruded plastic identification markers

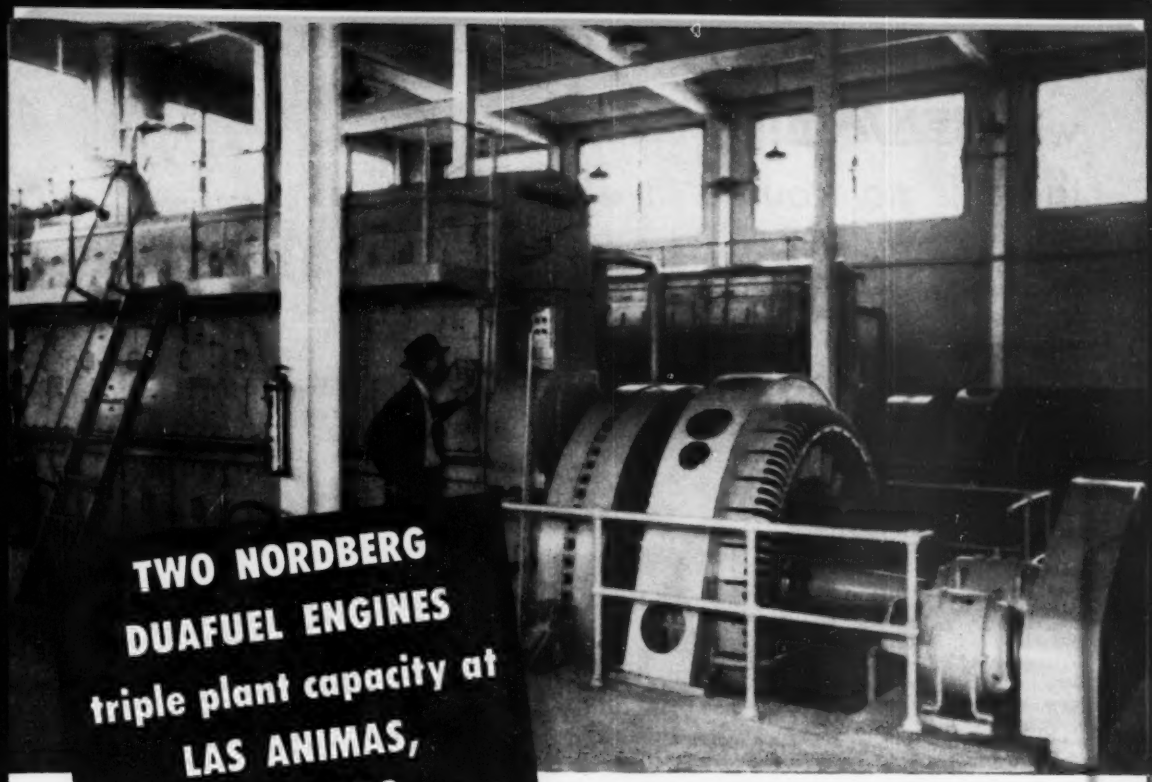
Ask for Catalog No. 22

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

TELEPHONE RAHWAY 7-8800 — CABLE ADDRESS NATVAR: RAHWAY, N. J.

221 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY



TWO NORDBERG DUAFUEL ENGINES triple plant capacity at LAS ANIMAS, COLORADO

DUAFUEL UNITS TAKE OVER BULK OF LOAD FROM OIL BURNING ENGINES AND PURCHASED POWER: WILL BOOST PROFIT $50,000 A YEAR

Two new Nordberg Duafuel engines installed in the Las Animas Municipal Light & Power plant at Las Animas, Colorado are already setting an enviable record of service. Since the engines were installed late in 1951, plant capacity has been tripled and an era of low production costs and high profits has been introduced. Now — for the first time in its 10 year history, the Las Animas plant is capable of carrying the city's demand, independent of purchased power. Cost studies indicate that there will be an increase in electric department profits of $50,000 a year.

The Nordberg installation comprises one 1610 hp supercharged unit and one 1165 hp non-supercharged Duafuel engine. Both are four-cycle engines with eight cylinders of 16″ bore and 22″ stroke, developing rated horsepower at 327 rpm. Capacities of the engines are respectively 1130 kw and 735 kw.

Las Animas acquired its municipal power plant in 1941 from a private utility serving the area. The city then installed in the power house 3 Diesels, with sea level ratings of 450 hp, 375 hp and 225 hp giving Las Animas an effective capacity of less than 750 kw. Peak load originally was 600 kw and rose continuously year by year to finally reach 1200 kw in 1950.

This meant increasing dependence on the utility company and entailed ever larger demand charges plus the cost of purchased power. Concurrently fuel prices and other operating costs were rising and in 1950 the 2,883,000 kwh purchased cost $37,228.02 or 12.91 mills per kwh. The oil-burning engines produced a net of 2,267,680 kwh (after deducting plant use) at a total cost of $35,506.04 or 15.66 mills per kwh.

With demand on the utility approaching the capacity of the existing transmission line, a survey developed that the best solution was plant expansion and utilization of available natural gas. With the installation of modern Nordberg Duafuel engines, using fuel costing less than 4 mills per kwh, it is now calculated that total generating costs at Las Animas will be only 6.6 mills per kwh.

Here is one more outstanding example of the ability of Nordberg Duafuel engines to slash power generation costs.

Nordberg engines are built in a wide range of types and sizes from 10 to over 10,000 hp. Write for details, outlining your power requirements.

NORDBERG MFG. CO., Milwaukee, Wisconsin

P352

BUSCH-SULZER

NORDBERG

DIESEL ENGINES

with BENJAMIN'S complete line there is no trouble *at all* getting

Task Matched Lighting Installations

In the 400-page Benjamin Catalog, you'll find just the lighting equipment you need to provide lighting that is matched to the task.

No need wasting time trying to locate a source for this or that special unit . . . or figuring out an acceptable substitute. If the unit is needed in industrial and utilitarian lighting . . . you'll be sure to find it in the Benjamin Line!

You'll be sure to find that, not only is the unit you select correct in lighting design, but equally important, it is designed for extra long life operation under the special operating conditions for which it is intended. Whether it be for ordinary industrial use, installation in corrosive, dusty or explosive atmospheres, for indoor lighting or outdoor . . . the Benjamin Unit designed for the task can be depended upon to meet highest expectations for finest performance.—Benjamin Electric Mfg. Co., Dept. K, DesPlaines, Ill.

"MAGNA-FLO" SYSTEMS

Provide Over 300 Combinations for Matched to the Task Lighting.

Like all Benjamin Lighting Systems, the "Magna-Flo" line for use with the three T12 Slimline Lamps is complete! It is so complete because, basically, just three channel sizes and four types of reflectors form the backbone of almost unlimited systems to match any industrial lighting task.

B-3930

"VAPOLETS"

For locations with atmospheres containing moisture, non-hazardous dusts or vapors.

Available in three types of reflectors—Dome, Shallow Dome and Symmetrical Angle. These reflectors thread on to the vapolet housing by cast-iron ring. Choice of glass globes: plain, opal, heat-resisting, ruby, etc.

EXPLOSION-PROOF

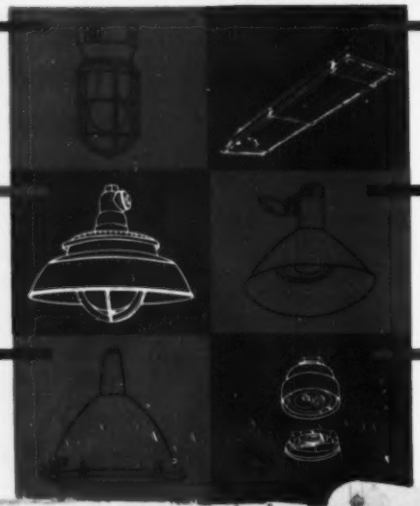
For locations listed by U. L. as Class I, Group C and D hazardous locations.

For lighting locations involving explosive atmospheres or explosive inflammable dusts, there is a complete line of Benjamin Explosion-Proof Units, available in a choice of reflectors, Dome, Flat Cone, Bowl, Symmetrical Angle; also choice of mountings.

"STEELITES"

For locations where keeping lighting levels up and upkeep down is a real problem.

An armored clad unit consisting of specially designed alzak aluminum reflector enclosed in a protective steel housing and a hinged, tempered glass cover which seals against dust, moisture and corrosive fumes.



"VAPOR-TITE" FLUORESCENT

For lighting locations where excessive amounts of non-combustible vapor or dust are present.

Approved as vapor tight by U. L., a one-piece porcelain enameled unit with hinged glass cover and easily accessible control equipment. Available in standard and angle mountings; also Plexiglass covers.

"ELLIPTO-LITE"

Most popular type floodlight ever designed for outdoor and protective flood-lighting.

For protective floodlighting of factory yards and grounds and for lighting outdoor work areas. A procelain enamel floodlight with auxiliary inner aluminum reflector; available with a removable hood construction, lowering attachment, choice of mountings.

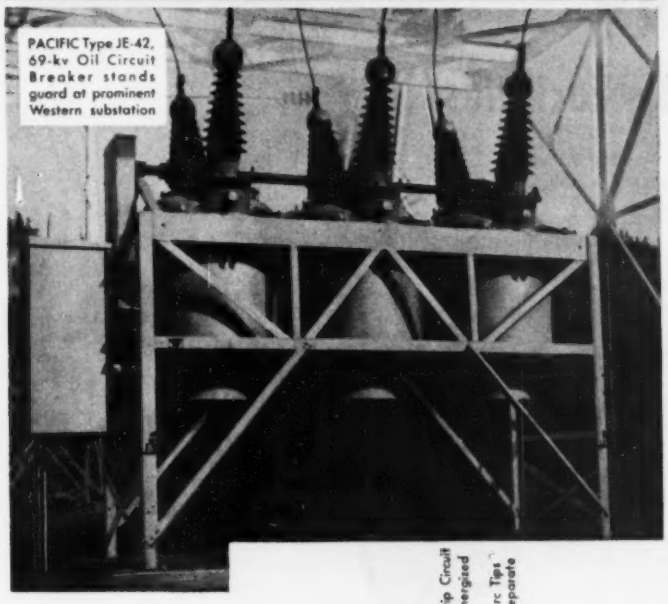
"TURNLOX"

Detachable Hood Construction available with 7 types of Incandescent Reflector Units to speed maintenance and cut costs.

Permits removal of lamp and reflector as one unit for cleaning on floor or at bench.

For complete details on this equipment or any of the more than 2,000 Benjamin lighting Units CONSULT YOUR BENJAMIN CATALOG . . . the encyclopedia of Industrial Lighting.

Advanced 69-kv Protection ...Blade-Travel Chart Shows Why



PACIFIC Type JE-42, 69-kv Oil Circuit Breaker stands guard at prominent Western substation

PACIFIC ELECTRIC

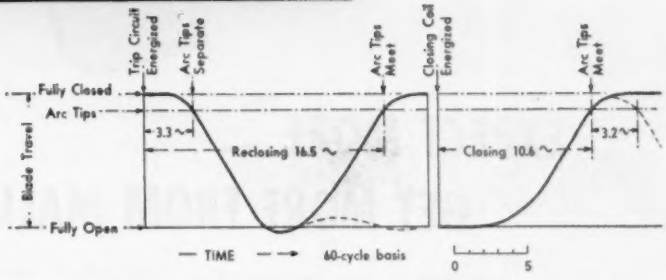
Type JE-42
Frame-Mounted

CIRCUIT BREAKERS

ELECTRICALLY and MECHANICALLY TRIP-FREE IN ANY POSITION

NEMA and ASA STANDARD

69 kv	Continuous	Interrupting
	600 amp	1,000,000 kva
(Also other styles 7.5 to 230 kv)	1200 amp	1,500,000 kva
	1200 amp	2,500,000 kva



At right: Blade-Travel Diagram (tanks filled with oil)

Open and immediate reclose shown at left of chart. Note full opening. Normal close shown at right. Dotted alternate shows start of opening after closing against fault.

THE APPLICATION Engineer needs only to glance at the blade-travel chart of the Pacific Type JE-42 to know that here is something special and out of the ordinary in 69-kv breakers.

The fast opening and reclosing holds system disturbance to a minimum in the case of both transient and permanent faults, and the fact that reclosing is from fully open position assures no impairment of insulation during the critical surge time that follows an interruption caused by repetitive lightning.

The short normal closing time as well as the reclosing time is maintained constant regardless of variation or loss of control voltage. Consequently when closing against fault there can be no slow drift-in of blades which might result in electromagnetic blow-back of blades far enough to open the a-auxiliary switch in the tripping circuit before the relays can operate. Simmering arcs are thereby avoided.

The interior construction also exhibits other advanced features that contribute to reliability of operation, as well as to ease of adjustment and low maintenance cost. Catalog 550 tells about them.

Since 1906

SALES OFFICES or AGENCIES in PRINCIPAL CITIES

PACIFIC ELECTRIC MFG. CORPORATION

5815 THIRD STREET, SAN FRANCISCO 24, CALIFORNIA • 4500 HARRISON STREET, GARY 10, INDIANA

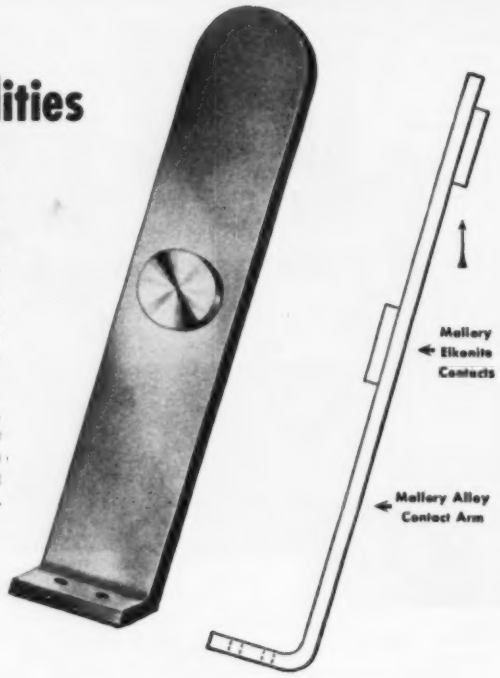
Why let electrical contact assembly snag your production?

Call on MALLORY Contact Assembly Facilities

You can save time, money and effort by turning to Mallory for your electrical contact assemblies.

This contact assembly for an electrical power control is an example of Mallory ability in design refinement and production economy. The contacts must break heavy currents without sticking. The contact arm needs low electrical resistance, and must withstand repeated impact without distorting. And the complete assembly must be produced at reasonable cost.

Through the use of Mallory Elkonite® contacts . . . high-strength Mallory copper-base alloy for the contact arm . . . special Mallory brazing methods . . . Mallory designed and produced an assembly that met all requirements of dependability and economy.



EXPECT MORE... GET MORE FROM MALLORY

If you have been producing your own electrical contact assemblies, it will pay you to investigate the advantages of Mallory Assembly Engineering. You can rely on Mallory to produce the right contact at the right price. Your requirements receive the attention of Mallory specialists who have pioneered the development of new alloys, brazing techniques and fabrication methods especially applicable to contact assemblies.

Production of complete assemblies in Mallory's recently expanded plant relieves you of all problems of purchasing, stocking, and fabrication of component parts and sub-assemblies. The finished assemblies delivered to your plant are backed by Mallory's single responsibility, extending all the way from raw materials to final inspection.

Write to Mallory today about your contact assembly problem.

In Canada, made and sold by Johnson Matthey and Mallory, Ltd., 110 Industry St., Toronto 15, Ontario

Electrical Contacts and Contact Assemblies

P R MALLORY & CO Inc

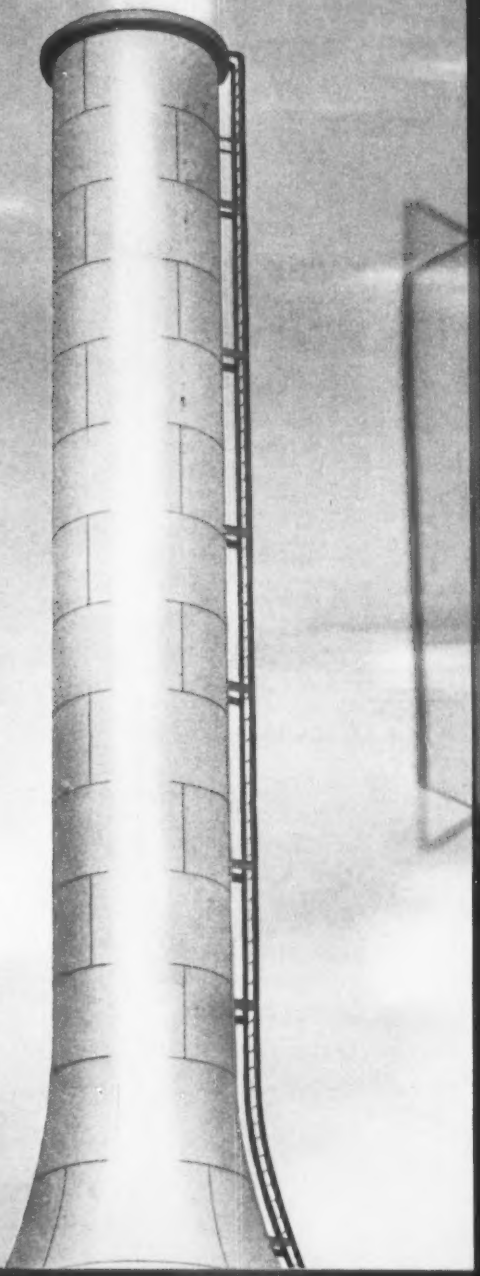
MALLORY

SERVING INDUSTRY WITH THESE PRODUCTS:

Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Dry Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

P. R. MALLORY & CO., INC. INDIANAPOLIS 6, INDIANA

American Blower . . . a time-honored name in air handling



Look at the almost total absence of fly ash from this stack. This is due to an American Blower Fly Ash Precipitator. On a given application, as the load falls off and fly ash becomes harder to catch, this precipitator automatically maintains a higher efficiency than any other collector of mechanical type.

AMERICAN BLOWER

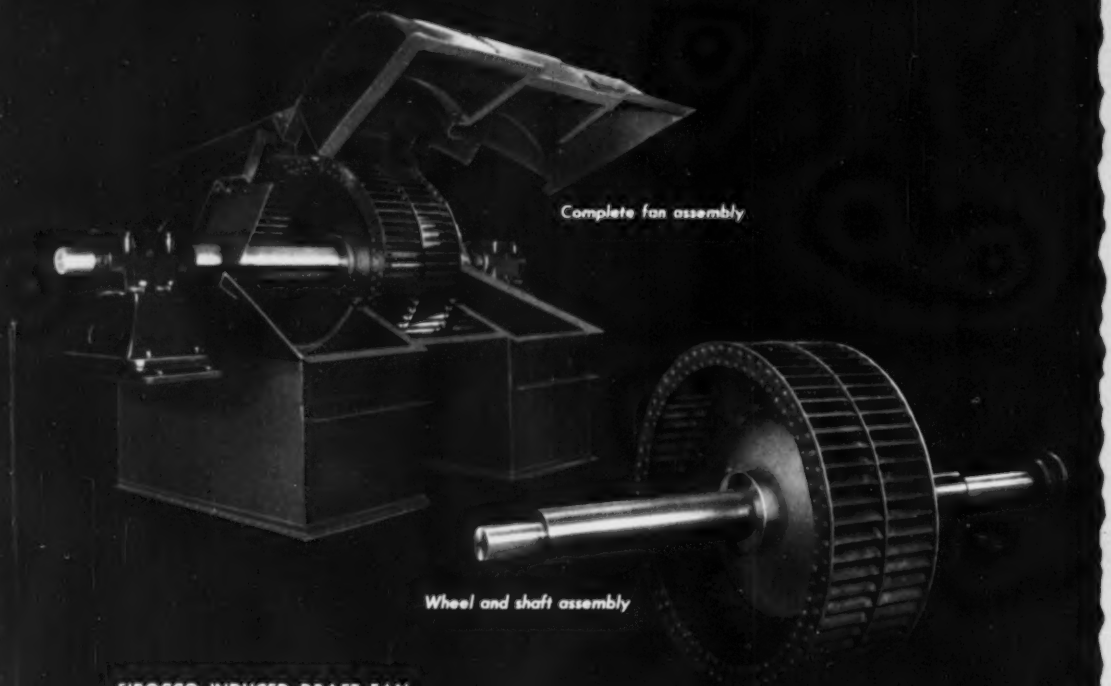
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

American Blower . . . a time-honored name in air handling



SIROCCO INDUCED DRAFT FAN

Memo to Power Plant Men:

You can handle more gas per revolution at lowest tip speed with Sirocco Multi-Blade Fans than with any other type. Designed and proportioned especially for induced draft work, their operating characteristics make them particularly adaptable to your modern power plant needs.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

Serving home and industry

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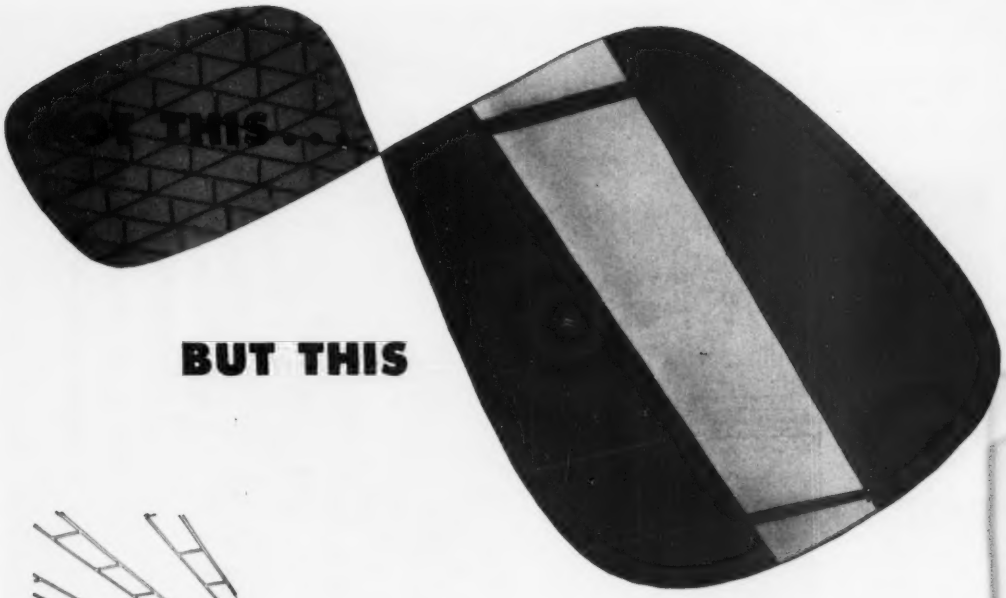
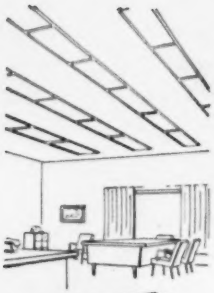
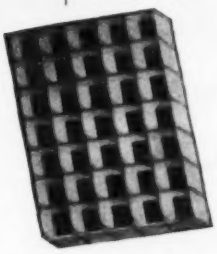


BUT THIS





The tiny opal louvers are part of the glass itself—will not deteriorate with age or weathering—save metals—lower maintenance costs.

Corning's FOTA-LITE gives you louvered light without the "egg crate" effect

Dust-catching louvers reduce the efficiency and mar the beauty of louvered lighting installations, but with Corning's FOTA-LITE, there is no such problem. The louvers are actually part of the glass itself . . . presenting a smooth, flat surface that can be wiped clean quickly.

Thousands of tiny opal louver cells permanently embedded in its 1/8" thickness diffuse light evenly at normal viewing angles giving the glass the appearance of plain opal. Vertical light is practically unrestricted. Not color-selective, FOTA-LITE transmits the true color of the light source . . . gives unusual light quality.

FOTA-LITE is strong, light in weight, and free of warpage. It is ideal for enclosed fixtures, totally luminous ceilings . . . wherever louvered lighting *without bulk* is desired. Louvers in the standard product are accurately designed for 45° cut-off. For other applications, a wide variety of patterns can be produced in the glass.

FOTA-LITE is featured in ceiling installations and top quality luminaires by the leading manufacturers of lighting fixtures.

For complete information send for Bulletin LS-32 which describes FOTA-LITE.

CORNING GLASS WORKS
CORNING, NEW YORK

Corning means research in Glass

VISIT THE NEW CORNING GLASS CENTER

Technical Products Division: Laboratory Glassware, Signalware, Glass Pipe, Gauge Glasses, Lightingware, Optical Glass, Glass Components

CORNING GLASS WORKS, Dept. EW-5, Corning, N. Y.
Please send ☐ Bulletin LS-32 describing FOTA-LITE.

Name_____ Title_____

Firm_____

Address_____

City_____ Zone____ State_____

CHALLENGER IS SMOTHERED IN FIRST MINUTE OF FIRST ROUND!

The real hazard of a transformer fire is the resulting black-out of power and light service to homes, hospitals, defense plants and municipal properties. You can protect your customers by protecting your transformers with a BLAW-KNOX AUTOMATIC FOG SYSTEM.

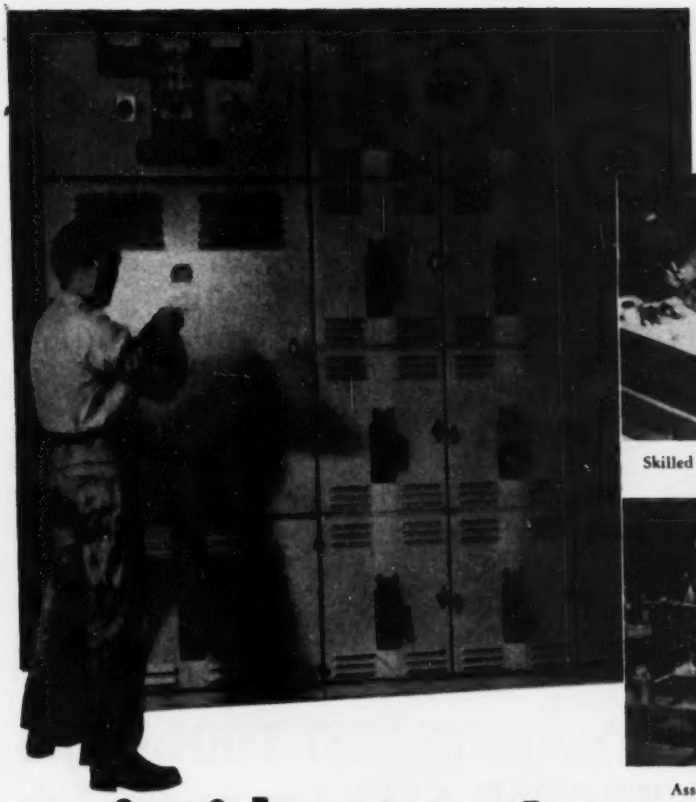
Through fast-acting, rate-of-rise thermostats, any critically hot transformer is instantly blanketed with a heavy, quenching "fog" of water, confining the damage and protecting adjacent areas . . . materially reducing power failures in both frequency and extent. Without obligation Blaw-Knox engineers will survey your fire hazards, make a layout of the most efficient system and estimate costs. Blaw-Knox Fire Protection Systems carry the approval of all underwriters.

BLAW-KNOX SPRINKLER DIVISION
OF BLAW-KNOX CONSTRUCTION COMPANY
829 Beaver Ave., N.S., Pittsburgh 33, Pa.
Offices in Principal Cities

"LITTLE JOEY SPRINKLER"
Always on the Job

Deluge Systems, Wet Pipe Systems, Dry Pipe Systems, Water Spray and Fog Systems, Rate-of-Rise Sprinkler Systems, and Foam and Carbon Dioxide Extinguisher Systems.

BLAW-KNOX
AUTOMATIC FIRE PROTECTION SYSTEMS



Final assembly of custom-built, low voltage, metal-clad switchgear.

Skilled workers assemble precision instruments.

Assembling Duo-Roll air break switches.

inside story!

Last April we opened an additional plant in Bethlehem, Pennsylvania. It is not only our newest but our largest. Because of this, we've been able to greatly increase our production of the precision-designed, dependable electrical equipment for which Roller-Smith and Elpeco have been noted since the early 1900's. We are happy to be in a position to supply increased amounts of equipment at a time when it is so badly needed and do it in a relatively short time. Despite universal material shortages and our greatly increased production you can be sure, that we . . . on the "inside" . . . are maintaining our same high standard of quality. If you need superior electrical equipment, either for yourself or as part of a defense order, contact us at once. We can't promise everything you might need, but perhaps we can help solve some of your particular problems in a surprisingly short time.

Workman wiring large air circuit breaker.

ROLLER-SMITH

ELPECO

ROLLER-SMITH CORPORATION
BETHLEHEM, PA.

WHY DO IT THE HARD WAY? . . . . *by BUSTER*

There's a CRESCENT TOOL in the PROPER SIZE for every job

CRESCENT not only makes a wide variety of daily-used Hand Tools . . . but makes them in a complete range of *sizes*. Good tools, like CRESCENT and CRESTOLOY, are designed to handle work loads within their generously-rated capacities. If Buster would read "How to Use Hand Tools," he would get a lot more mileage out of that fine Crescent Cabinet Screwdriver . . . and require less attention from the First Aid Department. CRESCENT and CRESTOLOY TOOLS are sold by Hardware Dealers and Industrial Distributors everywhere.

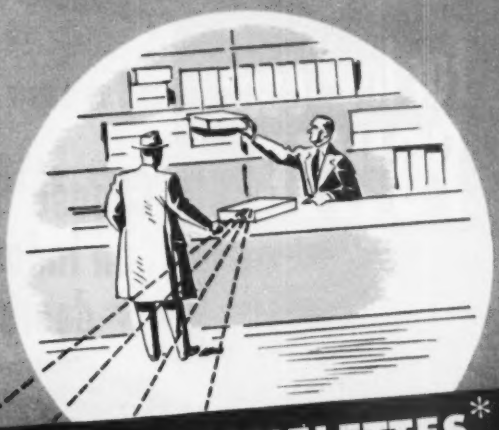
FREE BOOK

Has all the answers. It tells what tools to use and how to use them. Fully illustrated. A postcard will bring it to you. Send today.

Crescent is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

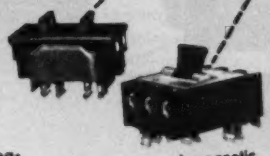
CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK

Off-the-Shelf DELIVERY!

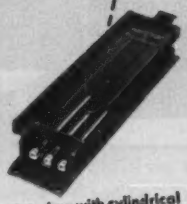


SQUARE D "PLUG-IN" PANELETTES* FOR LIGHTING AND POWER SYSTEMS

•Trims and boxes separately packaged. Flush or surface type. Flush lock—directory frame—ample knockouts.



•"Plug-in" thermal-magnetic circuit breakers—individual cartons. 15 to 100 ampere ratings available.



• Interiors with cylindrical bus bars and neutral plate.

NMO

•"Plug-in" lighting panelettes for 2 to 40 circuits—lugs or circuit breaker mains. 15 to 50 ampere 120/240 volt A.C. circuit breaker branches.

MHP

•"Plug-in" distribution panelettes for 240 volt, 3 phase, 3 or 4 wire A.C. systems. 15 to 100 ampere breaker units, power or lighting applications.

TIME SAVERS—varying job requirements can be met by using different combinations of standardized components—immediately available from Electrical Distributor stock.

MONEY SAVERS—moderate initial cost. "Plug-in" design reduces installation cost substantially.

LESS MAINTENANCE—sturdy, simplified design and construction. Positive-pressure contact jaws. Fewer bolted connections.

**a PANELETTE is an Underwriters' approved panelboard, packaged in component form for flexibility in stocking and "off-the-shelf" delivery.*

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

DETROIT · MILWAUKEE · LOS ANGELES

SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

For low-cost POWER...

Choose the fuel on Industry's doorstep

Coal is where you find it. Fortunately, however, a large share of the nation's operating Bituminous mines are located in Baltimore & Ohio territory—*economically accessible to America's great industrial plants*. The Bituminous mined here—practically on Industry's doorstep—is of excellent quality and in wide variety; whatever your specific need, there are B&O coals to meet it. Furthermore, the supply is *inexhaustible*—you can count on an *unlimited* reserve of B&O Bituminous, even in emergencies, for centuries to come.

When you consider fuel, consider cost—dependability of service—*accessibility*. You'll choose the Bituminous mined on the B&O. For advice, *ask our man!*

BITUMINOUS COALS FOR EVERY PURPOSE

LINKING 13 GREAT STATES WITH THE NATION B&O ®

BALTIMORE & OHIO RAILROAD

Constantly *doing things* —better!

Congratulations to the Winners of the

George A. Hughes Awards for 1951

Your successful promotions of major electric appliances during 1951 are achievements for which Hotpoint, as well as the entire electric industry, heartily congratulates you.

As a result of these accomplishments, you—during the past year—have led America's electric utility companies in bringing greater comfort and convenience to their customers through modern electrical living.

Hotpoint takes pride in recognizing the accomplishments of these outstanding utility companies and their employees—winners of the George A. Hughes Awards for 1951.

Utility Companies with Over 150,000 Meters

Southern California Edison Co., Los Angeles, Calif.
- Electric Kitchen Promotion

Carolina Power and Light Co., Raleigh, N. C.
- Electric Range Promotion

Metropolitan Edison Co., Reading, Pa.
- Water Heater Promotion

Cincinnati Gas and Electric Co., Cincinnati, Ohio
- Dishwasher Promotion

Pennsylvania Power and Light Co., Allentown, Pa.
- Commercial Cooking Promotion

Utility Companies with Under 150,000 Meters

Kentucky and West Virginia Power Co., Ashland, Ky.
- Electric Range Promotion

Central Ohio Light and Power Co., Findlay, Ohio
- Water Heater Promotion

Iowa Power and Light Company, Des Moines, Iowa
- Dishwasher Promotion

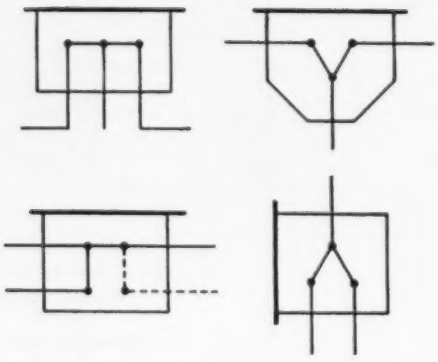
Hartford Electric Light Company, Hartford, Conn.
- Commercial Cooking Promotion

PLAN NOW to enter the 1952 Competitions. Watch for details—to be announced soon.

Hotpoint Inc.

5600 W. Taylor Street, Chicago 44, Illinois

DON'T CUT THOSE CABLES!
SAVE TIME AND MONEY BY INSTALLING
TYPE "OL" CABLE BOXES TO PROVIDE
DISCONNECTING LINKS FOR SECTIONALIZING.



"OL" CABLE BOXES

Heavy welded steel boxes with "Resistoyl" gasketed covers. Fitted with unit compound filled potheads for complete protection of cable ends. Location of potheads varied to suit installation conditions.

Boxes are filled with oil (or Askarel)—for minimum size and best electric characteristics.

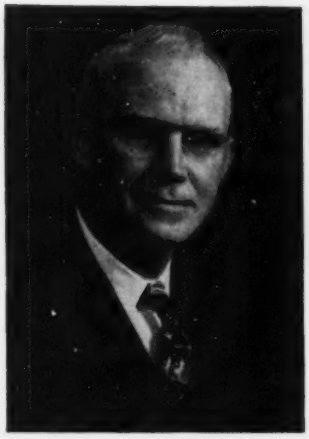
"OL" boxes meet many requirements for non-load break sectionalizing and stop joint connection of cables up to 66 Kv.

Send for new Bulletin BA52 on CABLE BOXES. (Page 10 lists "OL" boxes rated 15 Kv).

A SKETCH OR OUTLINE OF YOUR INSTALLATION CONDITIONS TOGETHER WITH YOUR CABLE DATA WILL BRING YOU OUR QUOTATION ON SUITABLE "OL" BOXES

G & W ELECTRIC SPECIALTY CO.
7780 Dante Avenue, Chicago 19, Ill.
Cable Terminating, Connecting and Sectionalizing Devices
Representatives in principal cities of U. S. A.
In Canada—Powerlite Devices, Ltd., Toronto and Montreal

Men who design, engineer and buy America's products rely on..and use..National Laminated Plastics because..



"One of the most important objectives of National's relationships with its customers is the never-failing, always-continuing program of engineering research and production control. We follow a policy of: The sale only *begins* when a sale is made . . . it only *ends* after the best processing methods have been coupled with rigid testing—to produce the best laminated plastic for the specific application."

F. Irving Crow
Vice President
National Vulcanized Fibre Co.

How much sock?

How much energy does a specimen of laminated plastic absorb in foot pounds per inch of notch? This impact tester is very important in the production control of National laminated plastics—very important in the research for better, stronger materials.

National Laminated Plastics
nationally known—nationally accepted

NATIONAL VULCANIZED FIBRE

A tough horn-like material with high dielectric and mechanical strength. Excellent machinability and forming qualities, great resistance to wear and abrasion, long life, lightweight. Sheets, Rods, Tubes, Special Shapes.

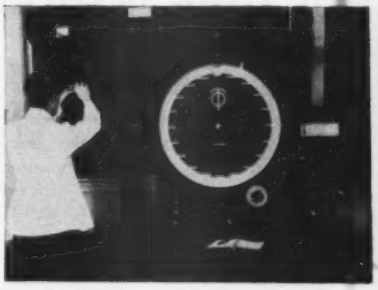
PHENOLITE Laminated PLASTIC

Phenolite possesses an unusual combination of properties—a good electrical insulator, great mechanical strength, high resistance to moisture; ready machinability, lightweight. Sheets, Rods, Tubes, Special Shapes.

National Vulcanized Fibre Company

Wilmington *Offices in* Delaware *Principal Cities*

Since 1873



"Specs" must

There's no equivocation with NEMA, Army, Navy or customer's specifications. "Specs" must be met. That's why National has the finest equipment for testing flexural, bonding, tensile and compressive strengths of all laminated plastics it produces. Such equipment is invaluable in the creation of new, better materials.

"Lab" in the Plant

Science speeds production—and deliveries—by making tests *right in the plant* of large, heavy Phenolite transformer stock for dissipation factor at 60 cycles. Portable equipment, exactly like the lab's equipment, is used on the spot—typical evidence of National's efficient production control.

LAPP PORCELAIN

IS YOUR GUARANTEE

OF LONG INSULATOR LIFE

Insulator life depends on soundness of porcelain, and assembly which gives it the best chance to live. For greatest insulator serviceability, look to the quality of the porcelain, and to assembly which recognizes the physical characteristics of the porcelain. Nowhere have these two requirements been the subject of more study, nor the object of more production care than at Lapp. The Lapp reputation for porcelain quality is ample basis for your confidence in the specification *"Lapp Suspension Insulators."*

Lapp

LAPP INSULATOR COMPANY, INC., LEROY, NEW YORK

Bartlett-Snow coal handling at *Bremo*

General View of Bremo Plant
Virginia Electric and Power Co.
Stone and Webster Engineering Corp.
Consulting Engineers

● The illustration above shows both the original building and the new addition of this 60,000 KW plant. All equipment including the track hopper, duplex feeder, 1326′ of belt conveyors, the 70′ dust tight flight distributor in the new addition, and the 111′ distributing belt and belt driven tripper in the original building were detailed and fabricated in our shops and installed by us to Stone and Webster's specifications. For maximum efficiency and fixed unit responsibility, let the Bartlett-Snow coal handling engineers, work with you on your next job.

View of Dust Tight Flight Conveyor
Distributing Coal to Bunkers (New Addition)

View of Belt and Belt Driven Tripper
Distributing Coal to Bunkers (Old Building)

DESIGNER ENGINEERS

BARTLETT-SNOW
CLEVELAND 5, OHIO

FABRICATORS ERECTORS

"Builders of Equipment for People You Know"

2-WAY RADIO SYSTEM TRIPLES EFFICIENCY OF MAINTENANCE TRUCKS

San Diego Gas & Electric Expansion Plans Will Put G-E Mobile Communication in More Service Vehicles

FAST-GROWING cities like San Diego, whose population has mushroomed 65% in 10 years, make heavy demands on utility equipment. Communications Supervisor L. J. Tank of the San Diego Gas & Electric Company describes his solution this way:

"**At the present time** 53 of our vehicles are equipped with G-E mobile radio. Our records show they are almost 3 times as efficient as our utility trucks that are not radio-equipped. Because these G-E units have paid off for us, our expansion plans call for more of the same."

We make a specialty of radio communication systems for utilities. The G-E Communications Man in your city is prepared to discuss General Electric's CAS* with you.

*Communications Advisory Service.

★

Overhead trouble trucks are radio-equipped. Dependability, a prime G-E feature, is top requirement in radio for utilities.

Radio Speeds Work – Instant communication with transmission department permits line foreman Ed Howley to coordinate operations at several points. Few tubes, simple construction make G-E equipment easy to service.

Central office communication system is tied in to mobile net. In 5 years peak load of this utility has jumped from 177,000 kw to 305,500 kw. The company now serves 198,000 customers, is still expanding facilities.

Hill-climbing jeep carries 2-way radio. Operator talks from high ground to valley over FM frequency. Static-free signal is clear in any weather. G-E units are engineered to take rough abuse in bumpy terrain.

You can put your confidence in—

GENERAL ELECTRIC

BLACKBURN
Copper-Bonded
GROUND ROD

the Underground Story . . .

. . . ON LASTING PROTECTION!

It's completely covered with a heavy copper sheath, molecularly bonded to the steel core for permanent protection.

It has an extra-rigid, strong steel core which will not bend on driving.

Its copper sheath is cold-rolled, hard, and scar-resisting, for driving in rocky soil.

It's produced in the middle west, strategically located for quick delivery to all parts of the United States.

Stocked by Leading Wholesalers

JASPER BLACKBURN CORPORATION

35 Madison St., St. Louis 6, Missouri Phone CEntral 3007

Distributed on the West Coast by KORTICK Mfg. Co.

NOW...Wagner Form W offer all these features...

When you choose Wagner Transformers—you get the benefit of improved design . . . better performance . . . longer life. Then, too, Wagner has a nationwide organization to provide fast, convenient service, with branches in 32 principal cities. Bulletins TU-180 and TU-181 give complete information on Wagner Transformers.

Wagner Electric Corporation EST. 1891

WAGNER ELECTRIC CORPORATION
6456 Plymouth Ave. • St. Louis 14, Mo., U. S. A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

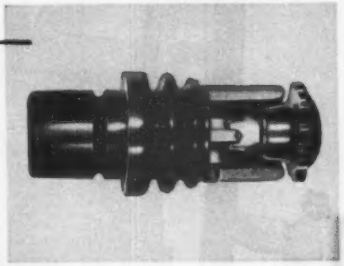
BRANCHES IN 32 PRINCIPAL CITIES

T52-13

Distribution Transformers

1

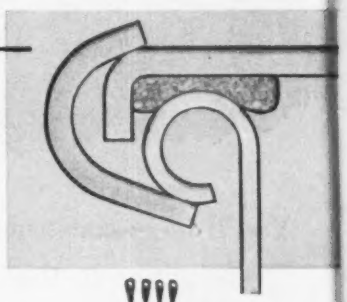
NEW HIGH VOLTAGE BUSHING



Wagner—pioneer in the use of tank wall mounted bushings—has developed a new high voltage bushing that means *faster, easier, safer* permanent transformer connections. *FASTER*—because the conductor is simply pushed in to the connector and tightened with a few turns of the knob . . . *EASIER*—no tools are needed . . . *SAFER*—the knurled knob is insulated to protect the lineman from accidental shock when tightening the terminal.

2

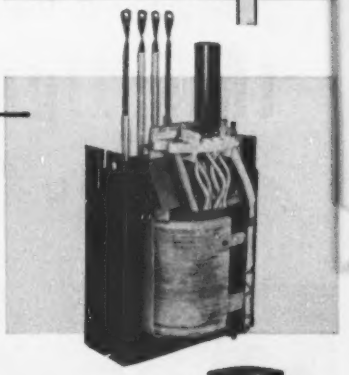
SHUR-SEAL COVER



Here's *true* sealed-tank construction! Covers are sealed to the tank with the Wagner SHUR-SEAL Clamping Ring. "Breathing" is completely prevented—no loss of oil can occur during shipment or handling. The SHUR-SEAL Ring maintains equal pressure all around the cover—yet permits easy accessibility by loosening a single corrosion-resistant bolt.

3

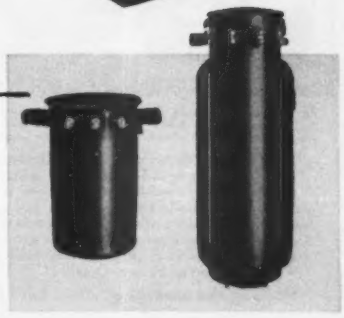
FORM W CONSTRUCTION



Wagner Form W Construction, with preformed cores of cold rolled, oriented grain steel, permits a liberal design in small size, light weight transformers that give excellent electrical performance. Core and copper losses are low . . . voltage regulation is good . . . exciting current is extremely low . . . and short time overload capacity is high. Form W Transformers pay dividends in longer service life.

4

INHIBITED OIL



Wagner pole-type distribution transformers are filled with inhibited oil, thus reducing oxidation to a minimum and retarding the formation of acids and sludge which ultimately cause its deterioration. This inhibited oil, in combination with the sealed tank construction provided by the Wagner SHUR-SEAL cover clamp adds years to the servicefree life of Wagner distribution transformers.

You'll meet construction deadlines and restore service faster by switching to this new FWD. You cut costs, too, because

this light-duty Model LD is a true 4x4!

An FWD earth boring rig with full-torque power take-off mounted on the new LD chassis.

The LD is a natural choice for materials transport. 14,500 lbs. gross vehicle weight.

This LD is a mobile "platform" for low cost, efficient tree trimming.

Look into the dollar savings and performance you can get with the new LD! This *light-duty* model has brought acknowledged FWD advantages to an entirely new FWD work range. AND — you can get the LD complete with the exact type of body and equipment you need! FWD is the *central source* for complete mobile workshops (78 combinations) . . . including cabs, winches, derricks, boring machines, platform and line bodies. Get full facts from FWD or a nearby FWD distributor. The Four Wheel Drive Auto Co., Clintonville, Wisconsin, and Kitchener, Ontario.

Built by the makers of America's Foremost Heavy-Duty Trucks

You buy more than a truck when you buy an FWD

Extra traction and proper distribution of weight and power give you all this:

- Ability to follow the job safely, on or off the highway.
- Ability to restore service faster — meet construction schedules — regardless of weather.
- Lower maintenance cost (up to twice the tire life).
- Up to twice the truck life.

World-Wide Sales and Service

Charlie Vaughn reports:

"In 12 years I've never had a complaint on the

LOCKE

6" Deadend!"

CHARLIE VAUGHN, our North Central Regional Manager, cut his eye teeth on the insulator business years ago in Georgia. Since then, he's sold and serviced insulators in every state east of the Mississippi, has bumped up against all kinds of operating conditions. With this background, Charlie can speak with authority on insulator performance. Incidentally, his Locke regional operation stretches from Wisconsin to Harrisburg, Pa., and south from Michigan to Kentucky.

"CURVATURE, CLEARANCE, THICKNESS,

make it the toughest 6" Disc on the market", says Charlie.

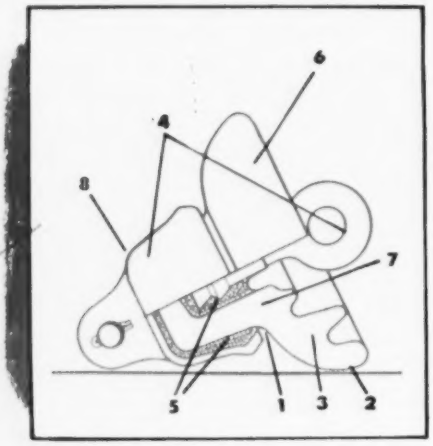
By *Curvature,* Charlie's talking about the way the Locke shell drops away from the cap at a larger angle than any other shells you've seen. This prevents breakage during shipment, and through various handling stages from our factory to your warehouse, and from warehouse to your job location.

By *Clearance,* Charlie means the spacing between the edge of the cap and shell. It's a good deal greater than normal. Charlie says this reduces the possibility of "donuting", helps insulator resist breakage when stresses are applied.

By *Thickness,* Charlie means the thickness of the porcelain shell in the sections at right angles to the surface of the porcelain. Charlie says this means that this 6" disc gives you a porcelain build-up other insulators don't have at points where you need it most . . . namely, points of greatest stress.

On next page Charlie illustrates these, and other advantages you get by using Locke 6" Deadends (our No. 16583) for your low voltage applications

Here Charlie Vaughn shows you why Locke's 6" Disc is the best insurance you can buy against breakage hazards—



1. Says Charlie, "Note larger clearance between edge of cap and shell. This prevents application of pressure on porcelain surface by edge of cap. This helps eliminate any chance of breakage."

2. "The top contour or curvature of porcelain has been so designed that the 'lay point' permits insulator to roll around in trucks, and across warehouse floors, without breaking," explains Charlie.

3. Charlie makes the point that "the thickness of the porcelain shell considerably exceeds that of conventional deadend insulators and thereby practically eliminates breakage".

4. "My customers are always impressed by the fact that the cap and pin are coated with the same coating we put on our high voltage insulators. It's Permazinc—Locke's quality-controlled hot dip galvanizing," says Charlie.

5. "Locke sand bands at the head of the porcelain shell put this zone in surface compression," says Charlie, "thus giving added strength and reliability."

6. "Another strength factor," reports Charlie, "is Locke Compression Glaze which makes the insulator stronger because of its ability to hold the surface in compression."

7. "No holds barred," asserts Charlie, "Locke Wet-Process porcelain is absolutely the best on the market. The answer is factory control operations. Come to our factory and see for yourself," Charlie always tells his customers.

8. "Electrical storms, snow and ice present no problems for our 6" disc," says Charlie. "Under these conditions, it simply has no equal."

YOU ARE EQUALLY SURE of getting a masterpiece of design when you specify other products in the complete line of Locke insulators and suspension hardware. Each pays off in superior performance on transmission and distribution lines, generating stations, sub-station and electrical apparatus. Locke Department, General Electric Company, Baltimore, Md.

LOCKE

LOW VOLTAGE PIN TYPE INSULATORS

HIGH VOLTAGE PIN TYPE INSULATORS

SUSPENSION INSULATORS

SWITCH & BUS INSULATORS

SPOOL INSULATORS

CUT INSULATORS

LIQUID-FILLED BUSHINGS

SUSPENSION & STRAIN CLAMPS

SUSPENSION HARDWARE

ENTRANCE BUSHINGS

CURBSIDE LOADING . . . All frequently used tools and materials are stored on the curb side—the safe side—of the truck.

IMPROVED ENGINEERING DESIGN . . . Derricks are carried at shoulder height. Hot sticks and ladders can be reached without climbing. Many other improvements.

FLUSH PANEL CONSTRUCTION . . . Pull type, *feather action* handles are flush with the side of the body. Two-stage lock strikers prevent doors from jarring open. Exclusive holder keeps doors open.

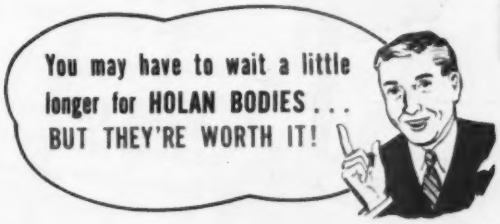
BETTER LOAD DISTRIBUTION . . . Holan bodies are engineered to place the weight more evenly on all four wheels, reducing strain on the chassis and reducing operating costs.

TWO PANEL DOOR CONSTRUCTION . . . Another first by Holan engineers! Reduces costs of maintenance, keeps the "new" look longer.

To GET the real low-down on the quality and performance of Holan utility bodies, ask the men who use them.

In the past few years Holan engineers have introduced many new features in utility body design. These features, according to the men who have used Holan bodies, are responsible for many economies in their utility construction, maintenance and service work.

Don't take our word for Holan superiority. "*Ask the men who use Holan bodies.*"



The dependable name in utility bodies

J. H. HOLAN CORPORATION

BODIES AND ACCESSORIES FOR UTILITIES
4100 West 150th Street Cleveland 11, Ohio

DISTRICT SALES REPRESENTATIVES

2754 N. 92nd Street
Milwaukee 10, Wis.

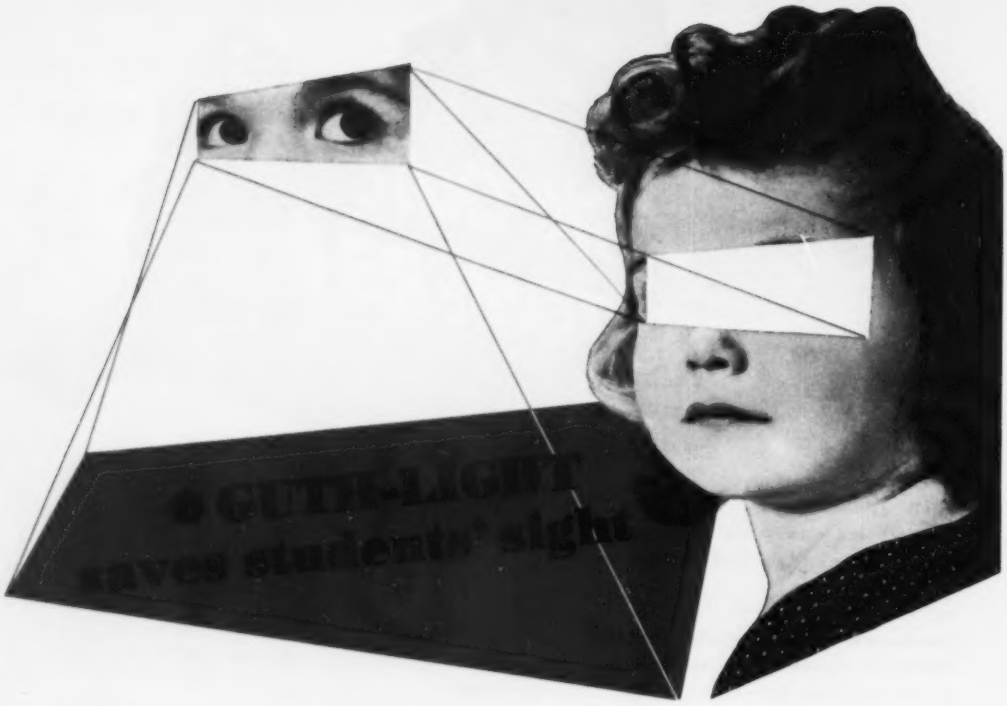
6-03 161st Street
Beechhurst, Queens, N. Y.

DISTRIBUTORS

Baker Equipment Engineering Co.
Summit and Norfolk Sts., Richmond, Va.

Baker Equipment Engineering Co.
2401 Hutchinson Ave., Charlotte, N. C.

Schatty Equipment Corp.
1810 S. E. 10th Ave., Portland 14, Ore.



Designed for maximum eye protection and see-ability. Economical in purchase, installation and maintenance.

SEELUX* *(Incandescent)*
3 ring, open-bottom for silver bowl lamps. ALZAK ALUMINUM** finish. Easy to clean.

E-LITE *(Fluorescent)*
Balanced lighting – 40% up and 60% down. Louvres hinge to either side for easy cleaning. 300° WHITE PERMALUX finish.

For complete information on GUTH Precision-Planned School Lighting, contact your GUTH resident engineer or write us for our catalog.

* Patent Pending **® and Patented, Aluminum Co. of America

THE EDWIN F. GUTH COMPANY / ST. LOUIS 3, MO.

19 Guth 52

POWER

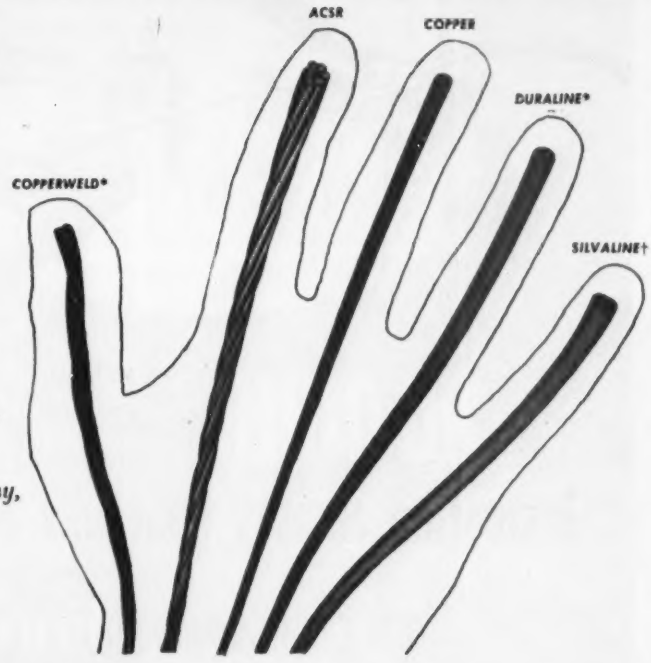
a vital need in rural areas

Anaconda understands this need. It recognizes the problems of rural power distribution. Anaconda knows that foresight and hard work on the part of the distributors of electric power have been largely responsible for overcoming these problems.

Rural power flows through ANACONDA *Conductors of copper, aluminum and Copperweld.*

Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

55464



*Reg. U.S. Pat. Off. †Trademark

the right cable for the job ANACONDA® wire and cable

NO OTHER
textile for electrical
insulation resists heat like FIBERGLAS YARNS!
THE NAME
IS A
OWENS-CORNING
FIBERGLAS

IF YOU MAKE OR USE

ELECTRICAL EQUIPMENT

IT WILL PAY YOU TO SPECIFY

FIBERGLAS* *insulating materials*

Nothing destroys the efficiency of most electrical insulations as quickly and surely as HEAT! With effective electrical insulating materials, smaller sized electrical equipment will deliver efficient service at higher temperatures.

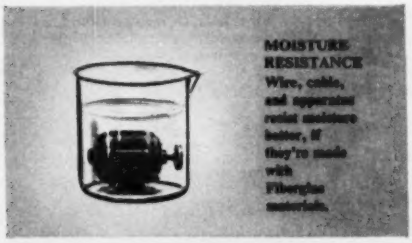
That's why, today, more and more makers and users of electrical equipment are specifying Fiberglas yarns as the vehicle for high-temperature insulating materials. Because Fiberglas yarns are glass in fibrous form, they will not burn . . . will not break down under extreme temperatures.

For example, Fiberglas-braided instrument wire resists high ambient temperatures, is unaffected by soldering heat. Fiberglas tapes, varnished cloths, sleeving and tubing, cords, and laminates, as used in electrical apparatus, resist high heat . . . deliver top service far longer than conventional materials.

So, if you're a maker or user of electrical equipment, remember to specify FIBERGLAS.

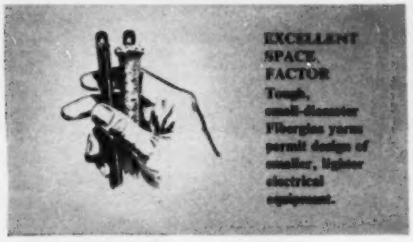
Electrical Sales Division, Owens-Corning Fiberglas Corporation, Dept. 858, 16 East 56th Street, New York 22, New York.

FIBERGLAS YARNS ALSO GIVE YOU THESE COST-SAVING ADVANTAGES

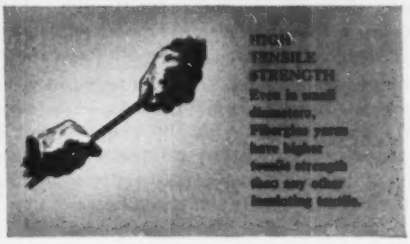


MOISTURE RESISTANCE
Wire, cable, and apparatus resist moisture better, if they're made with Fiberglas materials.

OIL AND ACID RESISTANCE
Fiberglas insulating materials resist the ravages of oils and acids.



EXCELLENT SPACE FACTOR
Tough, small-diameter Fiberglas yarns permit design of smaller, lighter electrical equipment.



HIGH TENSILE STRENGTH
Even in small diameters, Fiberglas yarns have higher tensile strength than any other insulating textile.

GOOD GUIDE TO A GOOD BUY!

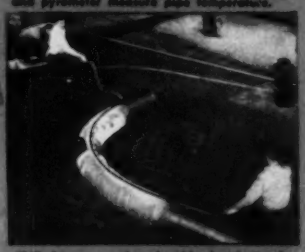
*Fiberglas is the trade-mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation.

What it takes to make steam behave *at 1450 psi and 1000° F!*

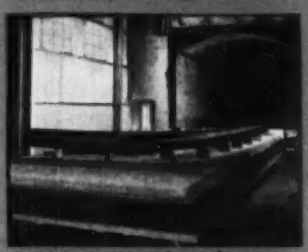
MAIN STEAM PIPING INSTALLED AT SALEM HARBOR STATION OF NEW ENGLAND POWER COMPANY

Manufacture of this main steam piping began at Pennsylvania Forge Corporation as 20-ton alloy-steel ingots (2½% chrome, 1% moly steel). Four days' forging changed the ingots into solid bars 30 ft. long, with outside diameter of 15½ in. Boring, turning, sizing and finishing followed.

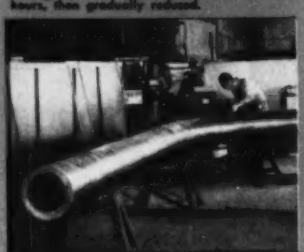
Bending furnace raises pipe temperature to 2000° F in 3 hours, 40 minutes. Thermocouples and pyrometer measure pipe temperature.



Skilled team completes bend in six minutes. Inside surface temperature dropped about 100° F.



Bend being loaded into furnace for stress relieving. Heat maintained at 1425° F for 4½ hours, then gradually reduced.



Ultrasonic inspection of wall after cleaning of pipe shows maximum thinning in bend of 1/16 inch.

FABRICATION of the main steam line for the Salem Harbor Station of the New England Power Company, vital link in more than 52 miles of piping fabricated by Grinnell, is an example of the *many* skills required of Grinnell piping specialists. Grinnell chemists, metallurgists, physicists, radiologists and supersonic electronic scientists . . . *all* played a part in the bending, welding and testing operations.

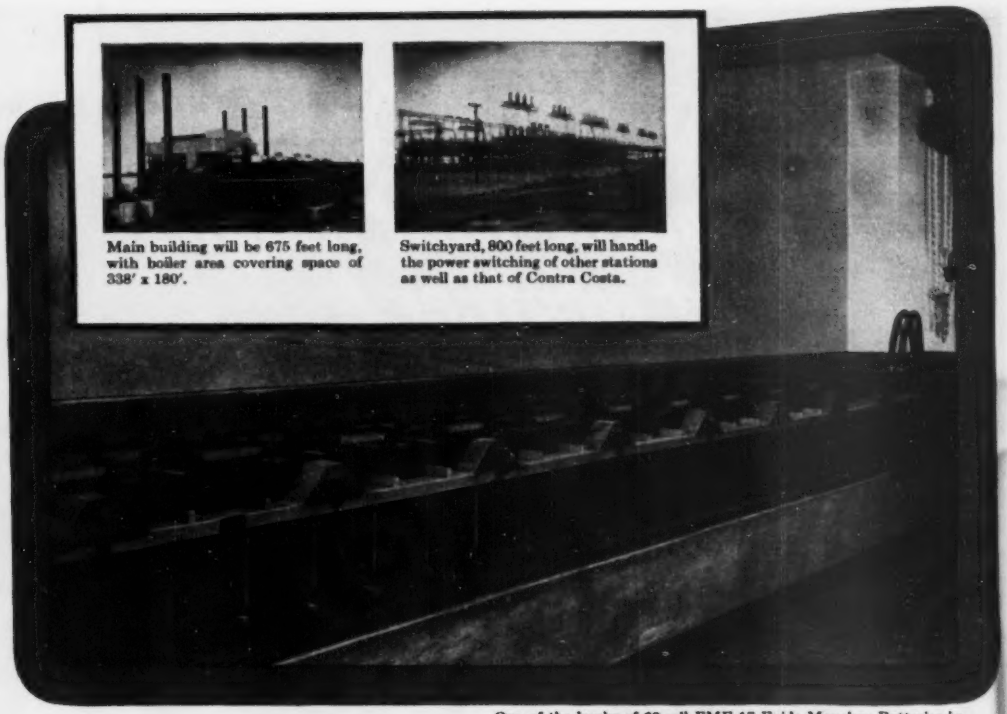
The integration of complex, highly technical skills like these into a *single* organization of trained specialists explains Grinnell's leadership in the field of prefabrication. It explains, too, why your interests are best served when you call upon Grinnell's expert personnel and specialized facilities in the solution of your piping problems.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



Main building will be 675 feet long, with boiler area covering space of 338' x 180'.

Switchyard, 800 feet long, will handle the power switching of other stations as well as that of Contra Costa.

One of the banks of 60-cell FME-17 Exide-Manchex Batteries in Contra Costa Plant, a duplicate of those in Moss Landing Plant.

IN P. G. & E.'s GREAT NEW CONTRA COSTA PLANT

Exide-Manchex BATTERIES

At Antioch, California, another giant unit of the Pacific Gas & Electric Company's vast system is nearing completion. It's the big Contra Costa Plant, equalled west of the Mississippi only by its power twin, the company's Moss Landing Plant at Monterey.

Officially placed in operation in July, 1951, the Contra Costa Plant will be producing at full capacity in 1953, when it will add 770,000-hp to the company's 58 hydroelectric and 17 steam plants now in operation. All plants are interconnected and form one of the largest power pools in the world.

In both the Contra Costa and Moss Landing Plants, are Exide-Manchex Batteries . . . used by many utilities because they assure:

POSITIVE OPERATION: Dependable performance at ample voltage with no switching failures.

INSTANTANEOUS POWER: High rates for switchgear operation with adequate reserve power for all other control circuits and for emergency lighting.

LOW OPERATING COSTS: Extremely low internal resistance.

LOW MAINTENANCE COSTS: Water required about twice a year. No change of chemical solution needed during life of battery.

LOW DEPRECIATION: Sturdy, long-life construction.

GREATER CAPACITY in a given amount of space avoids overcrowding.

These features combine to make Exide-Manchex *your best battery buy* for all control and substation services.

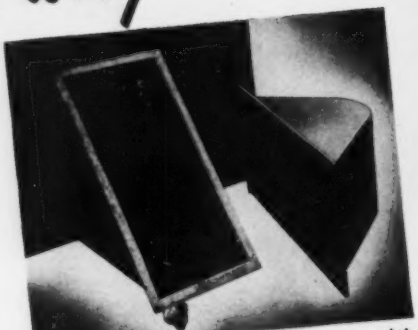
THE ELECTRIC STORAGE BATTERY COMPANY
Philadelphia 2
Exide Batteries of Canada, Limited, Toronto
"Exide" and "Manchex" *Reg. Trade-marks U.S. Pat. Off.*

1888 . . . DEPENDABLE BATTERIES FOR 64 YEARS . . . 1952

the motor that laughs at weather!

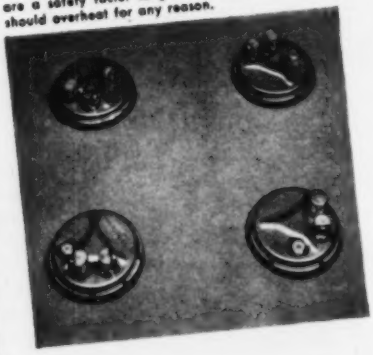
...Here's why

DIRT, DUST, DEBRIS can't get through this multi-layer air filter. The filter is slipped into a slot in the air intake, and the slot opening sealed with a gasketed cover.

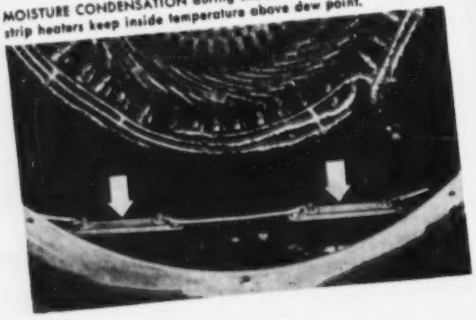


NO THOROUGHFARE FOR MOISTURE in these gasket-sealed conduit boxes—but plenty of room and easy access for making up terminal connections. Two other types of conduit boxes are available.

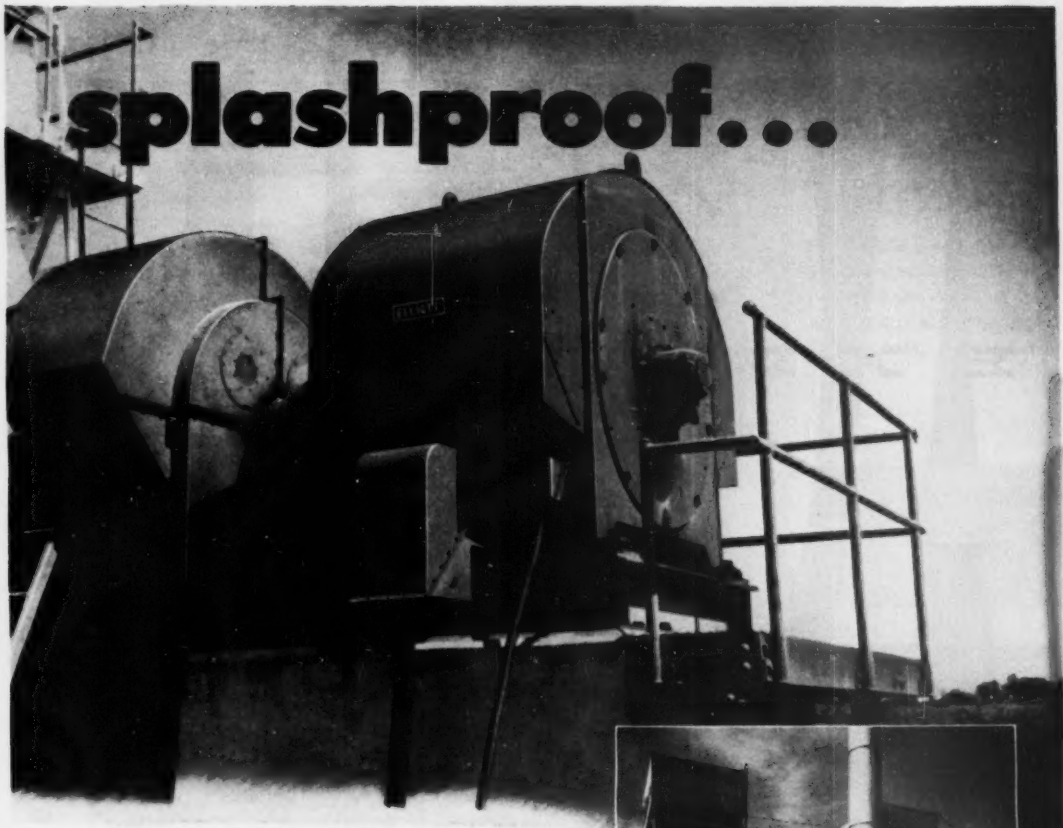
CONSTANT ATTENTION UNNECESSARY — these thermostats installed in coil extensions of stator are a safety factor to give warning if the motor should overheat for any reason.



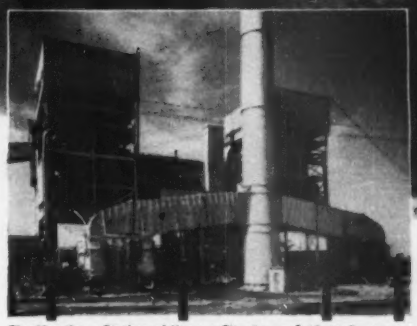
MOISTURE CONDENSATION during shutdown periods is out. Electric strip heaters keep inside temperature above dew point.



splashproof...



KANSAS CITY, MISSOURI has plenty of good old U.S.A. weather, all kinds. It also has the fine new Hawthorn Station of the Kansas City Power & Light Company—a semi-outdoor station designed and constructed by Ebasco Services, Inc. In this station four Elliott 500-hp, 700-rpm outdoor splashproof motors, located right out in the open at the base of the breeching, drive induced-draft fans through magnetic couplings. A close-up of one of these motors is shown above, and on the facing page, some of the reasons why the station designers selected these motors for the outdoor job... Other reasons are set forth in the Outdoor Motor Bulletin, on request. Other Elliott motors drive main auxiliaries such as boiler-feed pumps, circulating water pumps, forced-draft fans, and coal pulverizers in the new Hawthorn Station.



The Hawthorn Station of Kansas City Power & Light Company, under construction. Arrows show location of the four Elliott outdoor splashproof motors driving induced-draft fans. Forced-draft fans, also driven by outdoor splashproof motors, are located beneath boiler breeching just back of fans seen here.

Elliott outdoor splashproof motors are available in the third size above NEMA frames, and larger.

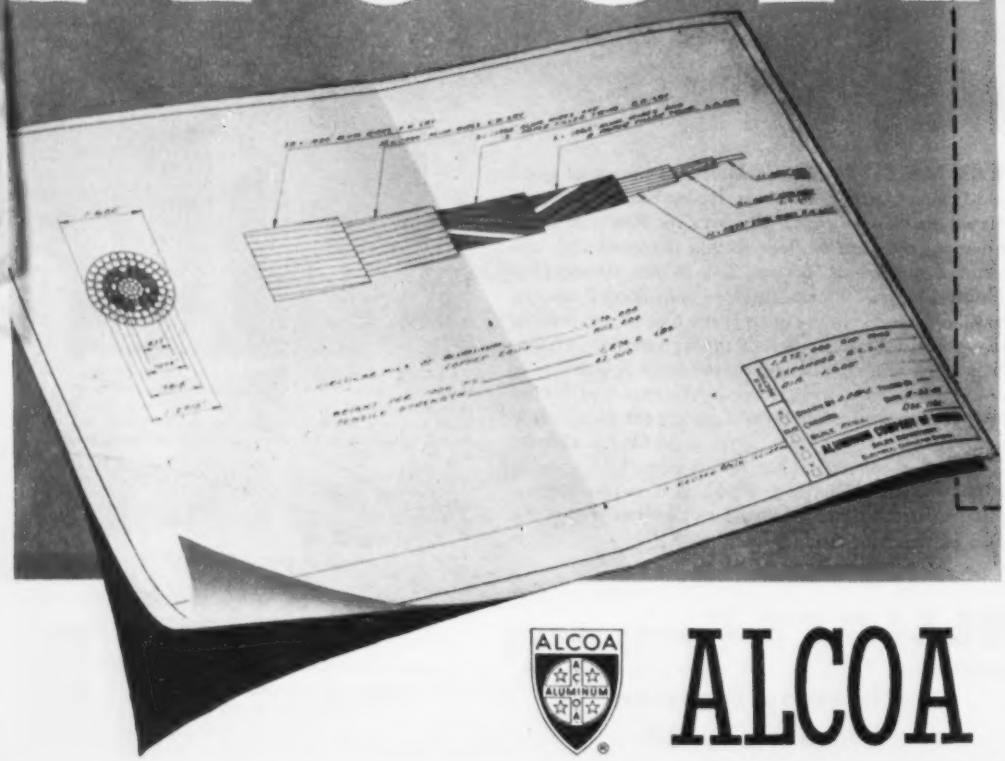
ELLIOTT Company

Ridgway Division
RIDGWAY, PA.

For motors 1—200 HP: Crocker-Wheeler Div., Ampere, N. J.
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

ACSR

EXPANDED



ALCOA

ALCOA

and Alcoa Leadership

Conductor for the highest voltage transmission line in America has been manufactured by Alcoa. Nearly two million pounds of 1.6-inch diameter expanded ACSR have been delivered and erected in West Virginia. This line will operate at 315,000 to 330,000 volts.

Expanded ACSR is designed to provide economically the large diameters required for conductors at super-voltages. The customary relationship between strength and loaded weight of conductor is maintained. The increased diameter of Alcoa expanded ACSR is thriftily obtained by introducing strands of processed paper twine in the intermediate layers of the cable.

Alcoa's introduction of expanded ACSR comes after twenty years of development and testing. It is the product of the same painstaking research, engineering, and manufacturing standards which have made Alcoa first in aluminum conductor. It is the latest of many developments that have established Alcoa's leadership in wire and cable, aluminum and ACSR.

Alcoa leads in quality, too, for Alcoa ACSR comes in but one grade—the best. The uniformly correct stranding, the high-quality galvanized steel core are evidence of this quality.

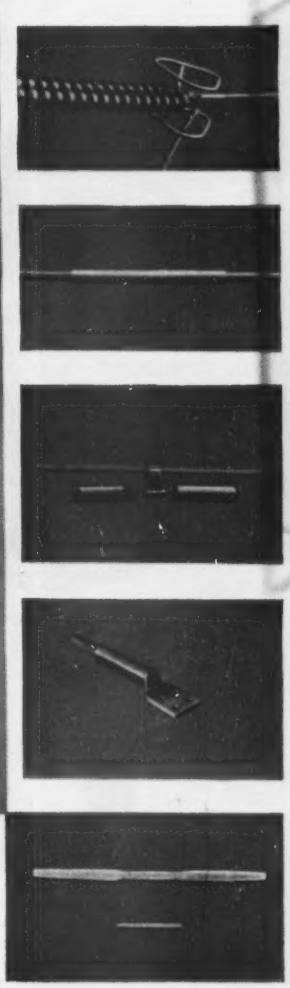
Look to Alcoa for leadership . . . first with the best in aluminum.

ALCOA TELEVISION—CBS Network, 6:30 P. M. to 7:00 P. M. EDST Every Sunday on most stations—8:30 P. M. to 9:00 P. M. in far west.

ALCOA ACCESSORIES

Alcoa offers a complete line of job-proven accessories for aluminum cable and ACSR.

ALUMINUM COMPANY OF AMERICA
2100-S Gulf Bldg. • Pittsburgh 19, Pa.



FIRST IN ALUMINUM FIRST IN A·C·S·R

1873 THOMAS INSULATORS our 79th year RELIABILITY 1952

DEMAND *Proof* OF PERFORMANCE

1907

● Fig. 1—In 1907, THOMAS was FIRST with the CAP-AND-PIN Suspension Insulator.

1952

● Fig. 2—In 1952, THOMAS is STILL the Standard of Comparison.

● Fig. 3—Typical "Quiet-Type" Insulator*.

● Fig. 4—Guy-Strain Insulators

Let us repeat, "All insulators are not alike". To make an insulator that will do its job the trouble-free way . . . over a span of many years . . . requires EXPERIENCE. Thomas has that experience.

Since the beginning of the Electrical Industry, Thomas has consistently kept pace with the Industry's astonishing growth. Two early mileposts in our progress come to mind.

In 1893, all of the porcelains used in the lighting arrangement for the World's Fair at Chicago were Thomas.

In 1907, Thomas designed and made the first Cap-and-Pin Suspension Insulator. UNITS INSTALLED THAT YEAR ARE STILL GIVING TROUBLE-FREE SERVICE AFTER 45 YEARS OF CONTINUOUS OPERATION.

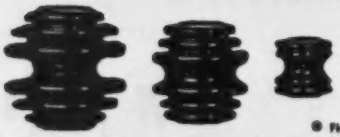
More recently, Thomas pioneered and patented a complete line of "Quiet-Type"* Insulators which are guaranteed to eliminate insulator radio interference.

These are among the many Thomas "Firsts" and contributions which have helped the Electrical Industry reach its present position.

TODAY, in our 79th year, we are ready with improved facilities and increased capacity to meet the most exacting needs of the Industry. After all is said . . . it's still quality that counts plus proper designing, precision manufacturing . . . and PROOF OF PERFORMANCE. Why gamble?

*Patent No. 2154387

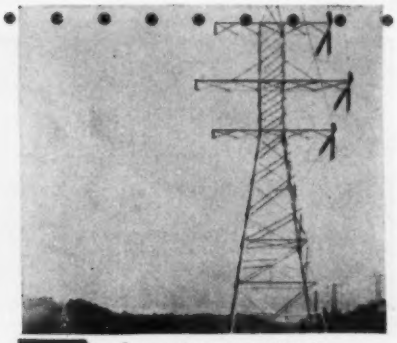
● Fig. 5—Pin-Type Insulators



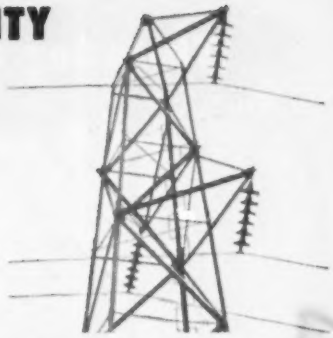
● Fig. 6—Spool Insulators.

ENGINEERS, MANUFACTURERS AND DESIGNERS SINCE 1873

FOR SUPERIOR INSULATOR QUALITY



1931 ● Fig. 7—2660-foot span of 69-mile, 132-kv line equipped with Thomas Insulators installed in 1931.

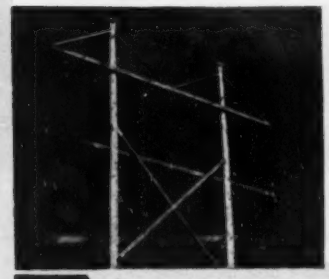


1907 ● Fig. 8—Central California line on which Cap-and-Pin Insulators were first used in 1907.

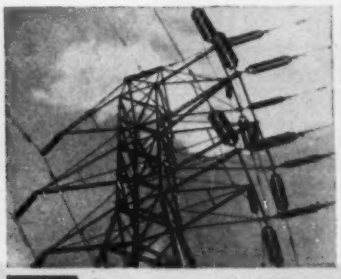
Specify Thomas Insulators - The Best by Line Test

The R. Thomas and Sons Company is a manufacturer and designer of all types of porcelain insulators . . . pin-type, switch, suspension, spools, guy-strain, bushings and special high-voltage porcelain. In addition, Thomas supplies associated line hardware, clamps, fittings, preformed armor rods, and so on.

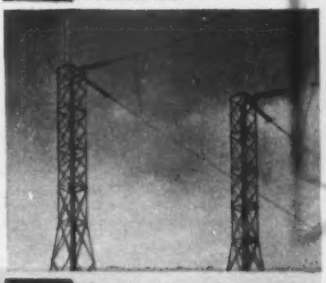
1938 ● Fig. 9—Large Western 230-kv line using 50,000 Thomas Insulators installed in 1938.



1948 ● Fig. 10—43,000 Thomas Insulators are installed on this 230-kv, 189-mile line.



1949 ● Fig. 11—5,000 Thomas Insulators make certain that this 132-kv, 14-mile line will give satisfactory service for decades to come.



1950 ● Fig. 12—On right-angle towers, Thomas Insulators have the stamina that assures long life and trouble-free performance.

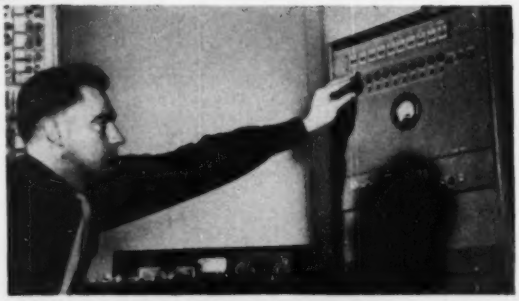
The R. Thomas and Sons Co.

LISBON, OHIO

NEW YORK CHICAGO

Sales Representatives: C. G. Anderson, Chicago • E. B. Anderson Co., *Detroit* • Ken H. Best, *Seattle* • R. E. Cunningham & Son, *Los Angeles* W. H. Eddy Products Co., *Phoenix, Ariz.* • Engineer Sales Corp., *St. Petersburg* • R. F. Hamilton & Associates, *Denver* • Geo. E. Honn Company, *San Francisco* • W. J. Hugo, *Minneapolis* • Leiser & Company, *Philadelphia* • John G. Pettijohn Company, *Knoxville* • H. E. Ransford Co., *Pittsburgh* • J. F. Schaefer & Co., *Kansas City* • R. J. Sullivan & Company, *Boston* • Tafel Electric & Supply Co., *Louisville* • Walter E. Thompson, *Birmingham* • Triangle Electric Supply Company, *El Paso* • United Electric Supply Co., *Salt Lake City* • Williamson Sales Co., *Shreveport, Amarillo, Dallas, Houston, New Orleans, Pine Bluff* • *Representatives in other principal cities*

Thunder Hunters



Thunder hunting equipment on location near Madison, Florida. Loop antenna on truck picks up static. The engineer in top picture is watching the indication of a circuit which registers how often the static exceeds a given level.

Many new telephone circuits have two jobs to do—carrying your voice and transmitting signals to operate dial exchanges in distant towns. And an old-fashioned thunderstorm can interfere with both!

"Rolling static" comes from many storms over a wide area and can interfere with clear telephone talk. A nearby lightning flash makes "crack static" which, unchecked, plays hob with dial system signals.

So Bell Laboratories scientists go "Thunder Hunting" in the storm centers of the United States – "capturing" storms by tape recorders. Back in the Laboratories, they recreate the storms, pitting them against their new circuits. This method is more efficient and economical than completing a system and taking it to a storm country for a tryout. It demonstrates again how Bell Telephone Laboratories help keep costs down, while they make your telephone system better each year.

BELL TELEPHONE LABORATORIES

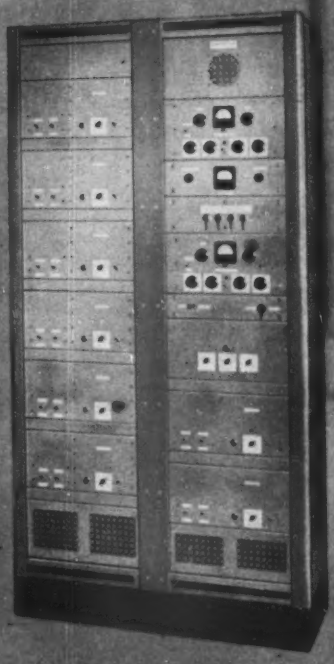
Improving telephone service for America provides careers for creative men in scientific and technical fields.

HOW POWER-PLANT MEN CAN SEE WHAT THEY'RE TALKING ABOUT!

Using a Gai-Tronics power-plant communication system, operators can *look* at and stay with their equipment instead of having to be *inside* the noise-proof enclosure necessary with other methods of plant communication. Thus, expensive equipment is under closer supervision and control because operators can remain nearby. Control panels, for example, can be read and talked about, as you stand before them.

Gai-Tronics systems are designed and built by men who have designed and built power plants all over the world. They *know* how noisy a power plant can be—how difficult communications are—particularly in an emergency. Because of their knowledge and experience, Gai-Tronics systems are built to provide *unstrained* hearing and speaking—regardless of plant noise level. And, a flick of a switch changes a Gai-Tronics system from speaker, to two-party and group-telephone conversations. Gai-Tronics systems bring a new standard of efficiency to everyday power-plant operation.

FREE:—To learn more about Gai-Tronics, write for the booklet, "Power Plant Communication Systems." Or, at your request, we will be glad to demonstrate a Gai-Tronics system in your plant—at no obligation!

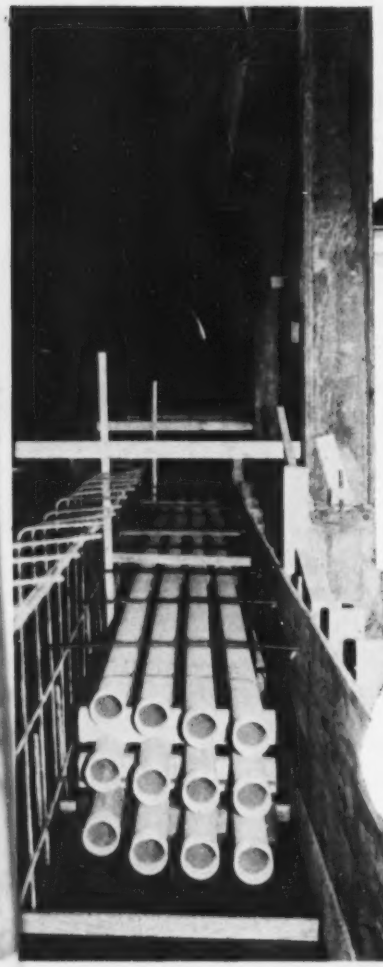


Typical control-and-amplifier cabinet for a Gai-Tronics power-plant communication system.

GAI-TRONICS CORPORATION

A SUBSIDIARY OF GILBERT ASSOCIATES, INCORPORATED

412 WASHINGTON STREET, READING, PENNSYLVANIA



Incombustible...

That's why TRANSITE® DUCTS confine burn-outs and protect adjacent cables

DESPITE modern precautions, the burn-out is still a potential hazard. Consequently, cables should be given the maximum fireproof protection that Transite Ducts provide.

Transite Ducts confine burn-outs, safeguard adjacent cables from damage and reduce the possibilities of panic and explosion because they are incombustible throughout. Made of nonflammable asbestos and cement, Transite Ducts will not burn, smoulder or generate smoke or fumes. They cannot contribute to the formation of explosive gases.

Nowhere is the fireproof protection of Transite Ducts so necessary as in such vital locations as subways, tunnels and power plants.

As the panel below shows, incombustibility is only one of the advantages of Transite Ducts. For more information, write Johns-Manville, Box 60, New York 16, N. Y.

4 OTHER REASONS WHY TRANSITE DUCTS DO A BETTER JOB AT LESS COST:

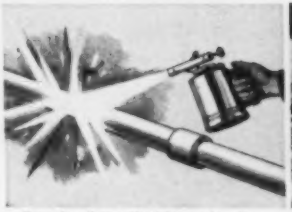
1. **Corrosion-Resistant.** Transite, being made of inorganic asbestos and cement, resists corrosion and is immune to electrolysis.

2. **Permanently Smooth Bore.** Transite makes long cable pulls easy. Danger of damage to cables is also minimized.

3. **Easy To Install.** Transite Ducts are light weight, easy to handle. Joints are quickly made. And long 10-ft. lengths reduce the number of joints in line.

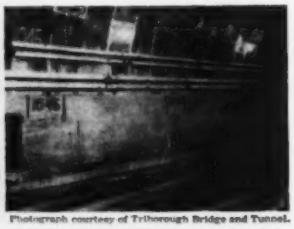
4. **High Thermal Conductivity.** Cables run cooler in Transite, reducing I^2R losses, increasing current capacity and prolonging insulation life.

In Subways, where passenger safety is paramount, fireproof Transite Ducts will, in the event of a burn-out, confine it and reduce the hazard of panic.



Transite Does Not Burn, smoke or fume because its ingredients, asbestos and cement, will not support combustion. It cannot contribute to the formation of explosive gases.

Transite Provides Heat Dissipation, Too. In addition to providing fireproof construction, Transite Ducts permit cables to run cooler, reducing I^2R losses.



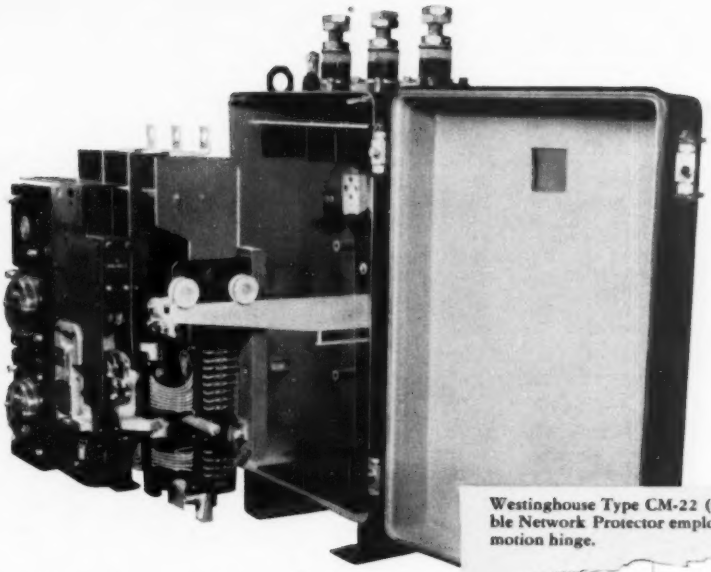
Photograph courtesy of Triborough Bridge and Tunnel.

In Vehicular Tunnels, if a burn-out should occur, Transite Ducts limit damage, permit speedier repair and an earlier re-opening for traffic.

Johns-Manville TRANSITE DUCTS

TRANSITE BOREDUCT—for installation in concrete

TRANSITE CONDUIT—for exposed work and installation underground without a concrete encasement



Westinghouse Type CM-22 (above) submersible Network Protector employs the new dual-motion hinge.

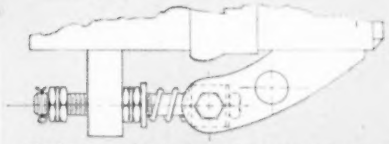
NEW, dual-motion hinge

SIMPLIFIES CLOSING OF NETWORK HOUSING

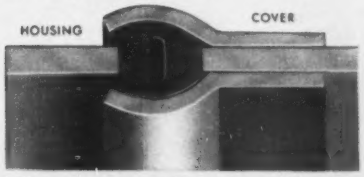
Now, the exclusive Westinghouse quick-opening, submersible Network Protector housing—which eliminated 26 to 44 bolts—has been further improved to simplify the operator's job. A new dual-motion hinge permits the cover to ride forward before it is swung open. This action relieves gasket pressure . . . leaves no restraining force to work against when closing the cover.

Your operators will like the simplicity and convenience of this Westinghouse "plus," as well as other housing features such as captive hardware, factory-adjusted stop nuts, and provision for hinging on either side. You'll like many additional, exclusive features built into all Network Protectors. For complete information, contact your Westinghouse Representative or write: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

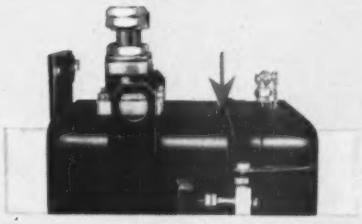
J-60790



Dual-motion hinge detail. Factory adjustment for centering cover is independent of adjustment for gasket deflection.



Tubular Neoprene gasket compressed between machined edges on housing and cover provides a tight seal.



Top of network housing showing uniform gap between housing and gasket before tightening cover. This prevents the hinge side of the cover from "rolling" the gasket.

YOU CAN BE SURE . . . IF IT'S

Westinghouse

NETWORK PROTECTORS

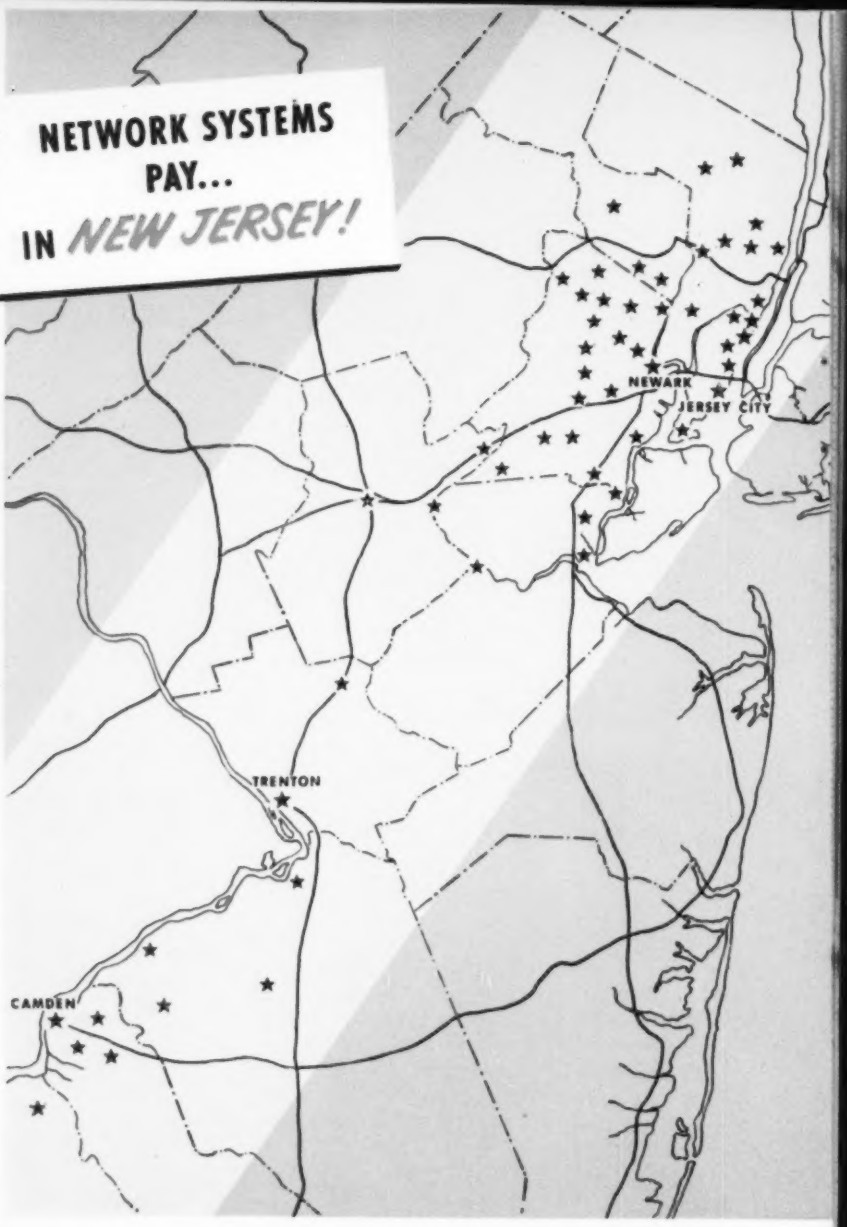
NETWORK SYSTEMS PAY... IN *NEW JERSEY!*

Newark, Underground Network

Clifton, Underground and Overhead

East Orange, Underground Network

Princeton, Underground Network



Trenton, Underground Network

Teaneck, Underground Network

Union City, Underground and Overhead

Moorestown, Underground Network

Advance Planning at its BEST!

Most interesting fact about this largest single utility group of networks is the unmistakable evidence that farsighted planning paid! For this alert utility took bold preventive action more than 20 years ago. And when peak loads had doubled, Public Service Electric & Gas Company of New Jersey was really ready!

Public Service serves 1,234,287 consumers in progressive and fast-growing New Jersey. It was among the first to recognize the long-range merits of the A-C Secondary Network System. Beginning in 1928, with its first network in Newark, Public Service had 5 in operation by 1930. By 1940, the number of networks had swelled to 90. Today this utility has a total of 94 networks . . . underground, overhead, and spot . . . serving a wide variety of load requirements in fifty-six communities . . . ranging in size from 4,189 to 438,776 . . . throughout this important industrial belt. The views on these pages show typical communities so served.

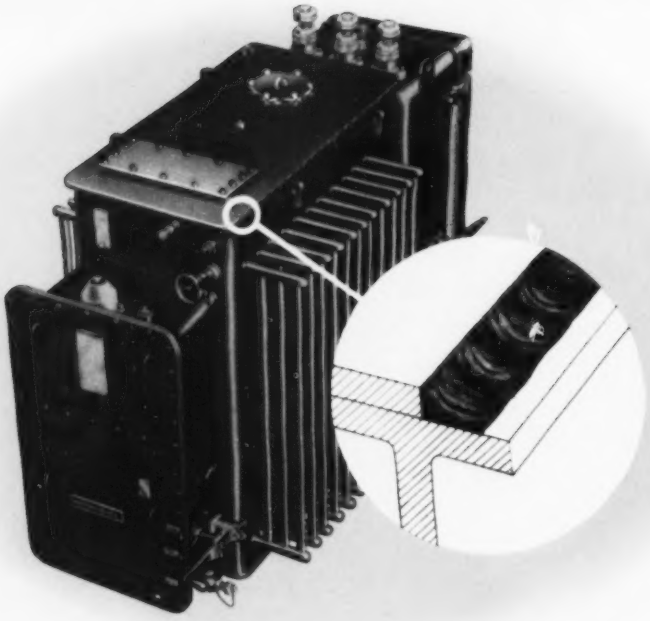
Because of intelligent advance planning, the tremendous expansion of the war and postwar years, which practically doubled peak loads throughout this network area, presented no problems! The unusual flexibility of the A-C Secondary Network System enabled Public Service to offer high standards of service continuity to small communities as well as large ones. The Network System can provide unusually high service continuity for your customers and reduce power distribution costs too! Investigate all of the economic advantages of the A-C Secondary Network System . . . now is the time to prepare for tomorrow's expanding loads. Call or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-97159

Westfield, Underground Network

Our Lady of Lourdes Hospital, Camden, Underground Spot Network

YOU CAN BE SURE...IF IT'S Westinghouse

NETWORK EQUIPMENT



NO COVER BOLTS! NO GASKET!

Another Maintenance Problem Reduced!

It's a major maintenance problem when oil sludges and insulation oxidizes.

Leakage of air and moisture is most likely to occur through the main cover gasket. That's why Westinghouse recommends welded-on covers for network transformers. Leaks are prevented . . . uncontrolled breathing eliminated.

It is still necessary, however, to gasket some switch and terminal chamber covers, bushings, oil gauges and handhole covers. Cortite* gaskets, composed of cork particles individually surrounded and bonded in special synthetic material, have been developed for this purpose. They provide a long-lasting, seepage-proof seal.

These two features, welded-on covers and improved gasketing for small openings, serve to greatly lessen the possibility of oil sludging and oxidation of insulation.

Removal and replacement of welded covers, if necessary, is easier and quicker than the gasket-and-bolt technique. For proof, ask your Westinghouse representative to arrange a showing of the ten-minute movie, "Welded-on". All operating and maintenance supervisors should see it. Phone today or write Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

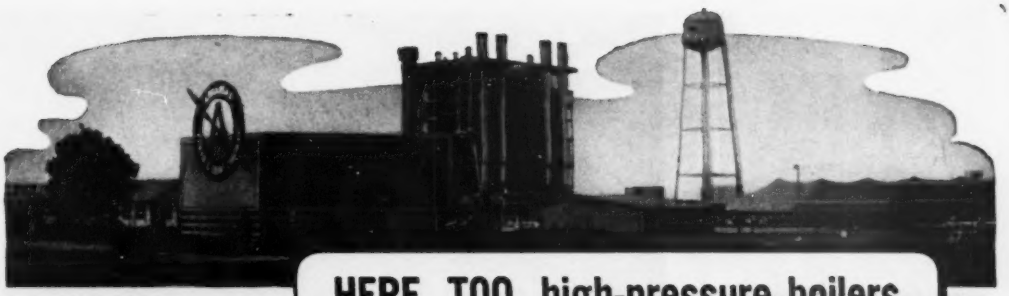
YOU CAN BE SURE...IF IT'S

Westinghouse

NETWORK TRANSFORMERS

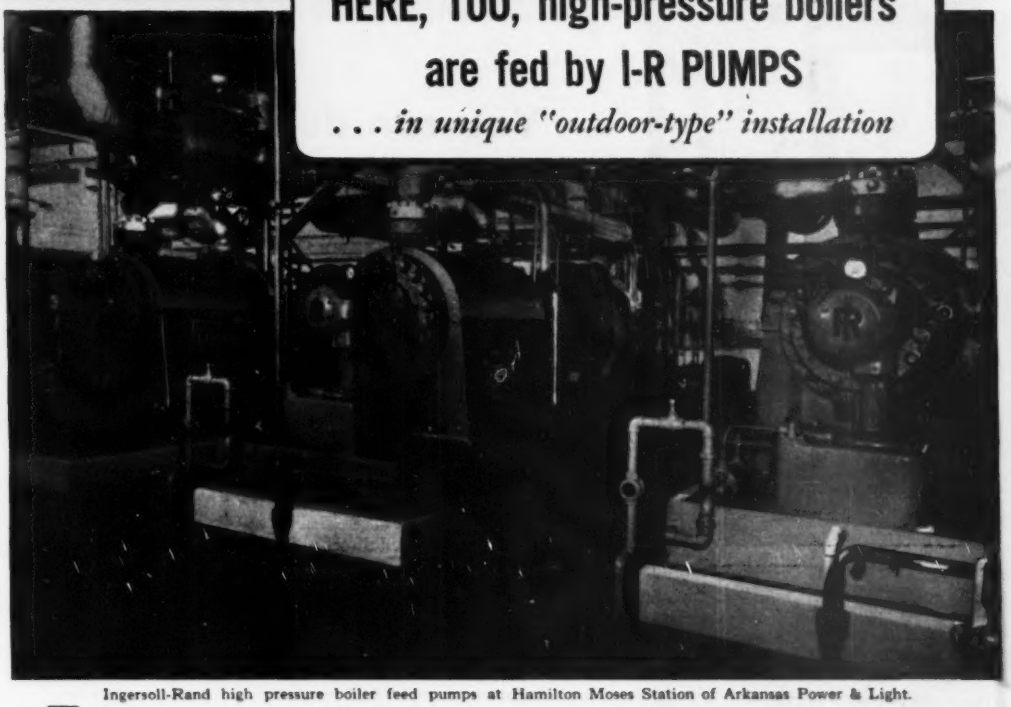
*Trademark

J-70622



HERE, TOO, high-pressure boilers are fed by I-R PUMPS

. . . in unique "outdoor-type" installation



Ingersoll-Rand high pressure boiler feed pumps at Hamilton Moses Station of Arkansas Power & Light.

The Hamilton Moses Station, dedicated last summer, adds another 132,000 kw to the fast-growing Arkansas Power & Light Company system. This new steam plant represents a modern innovation in central station design—outdoor-type boiler construction. Conventional brick and masonry buildings have been practically eliminated, even the turbines and generating equipment being housed in a retractable shed.

Six Ingersoll-Rand, 8-stage, Class CHTA boiler feed pumps supply the feed water requirements of the two generating units. Each pump is designed to deliver 768 gallons per minute at a discharge pressure of about 1550 psi. The pumps, three of which are shown above, are located just below the heater platforms.

The proved dependability, sustained high efficiency and low maintenance of I-R Class CHTA "double case" pumps makes them fit right into the picture, wherever continuity of service and economy of operation are important requirements. Your nearest Ingersoll-Rand representative will be glad to give you complete information on the boiler feed pump best suited to your particular plant requirements.

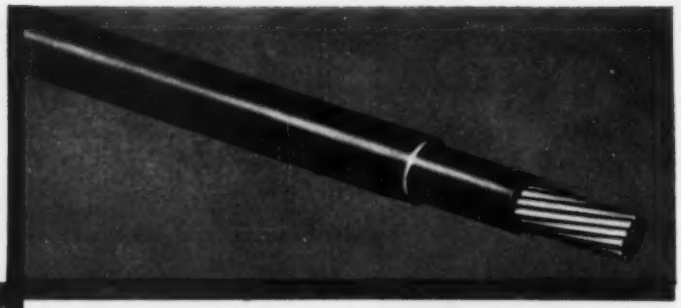
737-10

Ingersoll-Rand

CAMERON DIVISION

11 BROADWAY, NEW YORK 4, N. Y.

CONDENSERS • COMPRESSORS • DIESEL ENGINES • PUMPS • TURBO-BLOWERS • ROCK DRILLS • AIR & ELECTRIC TOOLS



You can depend on neoprene-jacketed cable in all types of service

RURAL • RESIDENTIAL • INDUSTRIAL

Wherever it's installed, neoprene-jacketed cable gives long, trouble-free service. Above ground, neoprene-jacketed cable outperforms other types because of its unequaled resistance to deterioration from sunlight and weathering. In heavily industrialized areas, neoprene stands up in corrosive atmospheres . . . is ideal protection for both primary and secondary power cable.

Underground, buried direct or installed in ducts, neoprene resists attack from soil acids. Unlike metallic coverings, it is not damaged by electrolytic action caused by stray currents.

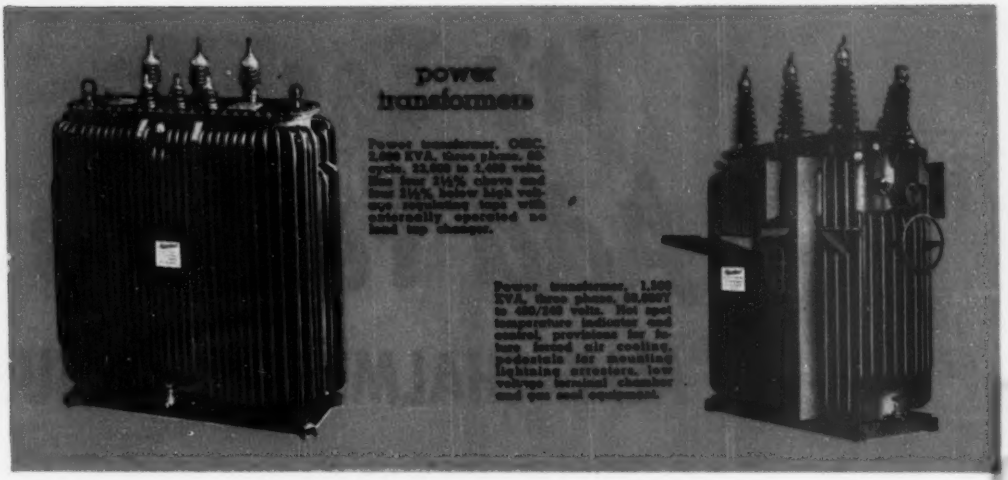
Cable manufacturers supply neoprene-jacketed cable in single and multiple conductor types in a range of voltage ratings. Since the same cable is often suitable for different uses, lower inventories are possible. And remember, a neoprene jacket assures longer life, fewer repairs, less frequent replacement even in the most severe service. E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division X-O, Wilmington 98, Del.

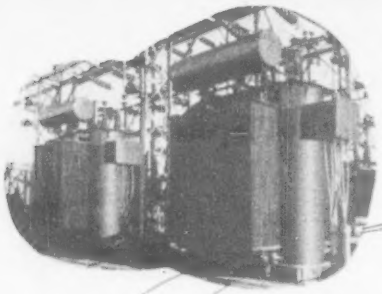
NEOPRENE

DU PONT

150th Anniversary

Tune in Du Pont "Cavalcade of America"—Tuesday evenings, NBC—coast to coast





When dependability is a factor...

Dependability in a transformer to you means trouble-free performance and long service life. To us, this means dependable construction.

For example, at STANDARD . . .

Tanks are built of rust-resisting steel, arc welded seams and tested under pressure. Liberal clearances are allowed from the windings and leads to tank and cover.

On the outside . . . attractive, long-wearing finishes with a primer coat and two finish coats of blue-gray enamel . . . on the inside, a lining of red oxide.

Covers are carefully and accurately fitted.

Tap changers and accessories efficiently placed with a specially designed tap changer switch.

These are just a few of the construction factors which STANDARD builds into Power Transformers. Look to STANDARD when you want dependability.

Everything Points To...

WRITE FOR BULLETIN CL-50

Tells the story with words and pictures of STANDARD'S complete line of transformers, and how they perform for every class of service . . . on the job.

Standard

THE STANDARD TRANSFORMER COMPANY

Trade Mark ®

WARREN, OHIO

REPRESENTATIVES IN PRINCIPAL CITIES

It's Easy to Add Feeders

ON AN ALLIS-CHALMERS UNIT SUB

When System Growth
Demands Additional Substations,
Install Allis-Chalmers Unit Subs.
They are Simple to Specify,
Time-Saving to Install and Easy to Expand
for Future Needs.

WHEN LOAD GROWTH MEANS EXPANSION . . . add substations designed to do more than just meet your immediate needs — add Allis-Chalmers Unit Substations with built-in flexibility for the future.

Then when future residential or industrial growth necessitates additional feeders, they will be easy to add. Each feeder of an Allis-Chalmers Substation is a complete unit in itself and is easy to install.

Here's How Feeders Are Added

Remove the bolted-on plates that cover the pre-cut bus and wiring openings . . . also remove the roof splice plate from the end feeder. Now bring the new feeder into position. You'll find correct alignment is easy, insured by jig-built construction. Replacing the gasketed roof-splicing plate completes mechanical connections.

Electrical connections are also simple to make. The pre-drilled, silver-plated bus extensions are bolted together. Easy-to-apply no-corona tape and insulating tape finish the joint. There's no compound to melt, chip, scrape, or crack. Control wiring is easy to connect because terminal blocks are grouped . . . located for ready access.

That's it! Connect feeder cables and the job is done.

MCS Unit Substations are a convenient answer to the growing distribution problem . . . to the ever increasing demand for power and yet more power. They are simple to specify, neat and modern in appearance, easy to expand, and they save you money these five ways:

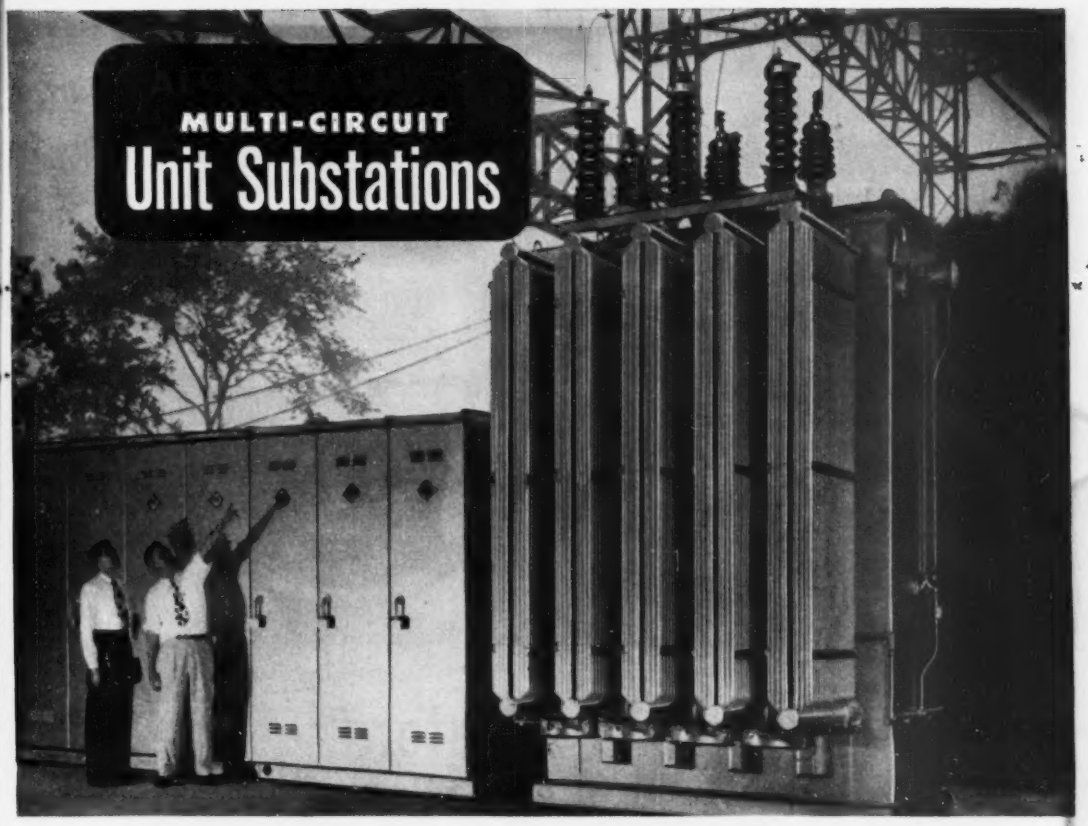
(1) Original equipment cost is low; (2) compact construction reduces space requirements and real estate costs; (3) pre-wired unit design speeds installation; (4) maintenance is quick and economical because of improved accessibility, and (5) you purchase only the feeders you need *now*, deferring additional expenses until load growth demands them.

For the full story on what Allis-Chalmers Unit Substations can mean in your distribution system, call your nearby A-C representative, or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3544

ALLIS-

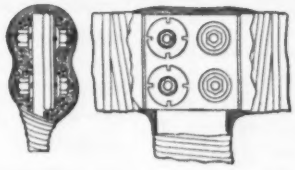
MULTI-CIRCUIT

Unit Substations

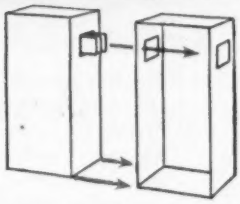


Here's Why Feeders are Easy to Add...

1 **FEEDER UNITS** are jig-built so that each feeder cubicle is exactly like every other one. Bus extension openings, control wiring openings . . . even small screw holes . . . are pre-cut in jigs. This careful, uniform construction makes field assembly easy. Just move the new feeders into position. Alignment is perfect.



2 **BUS JOINTS** are easy-to-make in the field. Bus extensions are pre-drilled and silver-plated . . . designed for quick, easy bolting together. No-corona tape covers the bolted joint . . . speeds the job by providing a smooth taping surface. Insulating tape finishes the joint. There's no compound to melt or apply.



3 **EACH FEEDER** is an individual unit . . . complete with two side panels, roof and floor. All enclosed parts are protected from the weather, dust or mechanical injury even during the last minutes of installation. Gasketed roof-splicing pieces fit easily into place forming a weatherproof seal.

CHALMERS

A-C ALLIS-CHALMERS

Sangamo J Meters

are quiet in operation

In the interest of good public relations, utilities must have meters that are quiet. Even when meters are installed outdoors, the point of installation may be on a wall near a bedroom that could act as a sounding board.

For this reason, great pains have been taken to make sure that Sangamo J Meters *are* quiet. The lamination assemblies are riveted with 15 tons pressure so that they do not vibrate according to the alternating current frequency.

To silence any vibration of the moving element, the upper guide bearing has been furnished with a stainless steel pivot of such length that its period of vibration is outside the resonant range of system frequency, and therefore, noiseless. This pivot is anchored in sound deadening alloy to dampen out the noise of vibration and to produce a meter which gives exceptionally quiet operation even under the most adverse conditions.

Only Measured Facts are Known Facts

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

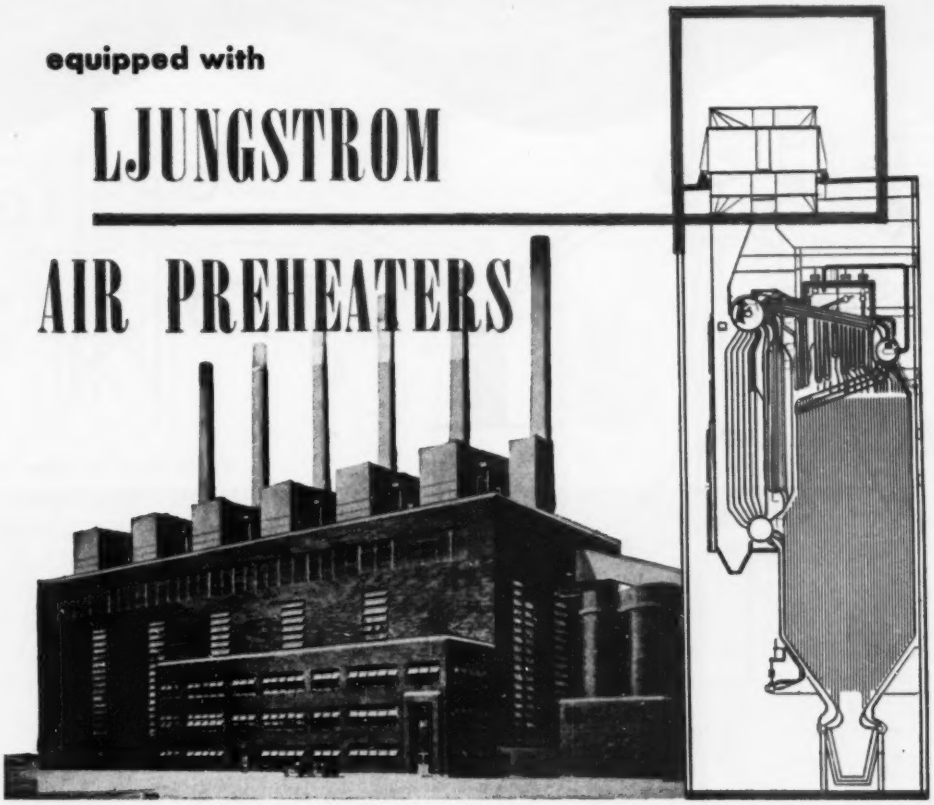
Sangamo J Meters have proved their ability to meet today's requirements and tomorrow's anticipated loads with sustained accuracy, economy of maintenance and troublefree performance.

SA52 5

Three Boilers at Noblesville Station of the Public Service Company of Indiana

equipped with

LJUNGSTROM AIR PREHEATERS



Public Service Company of Indiana, in its post-war expansion program, has added hundreds of thousands of kilowatts for the increasing needs of rural and industrial midwest.

The latest new station to go on the line is Noblesville Station, designed by Sargent & Lundy, Chicago, to add 90,000 KW to this utility's power output. Noblesville utilizes three Riley Steam Generating Units. Each unit is pulverized coal fired, with a capacity of 300,000 lb of steam per hr at 1025 psi and 950 F.

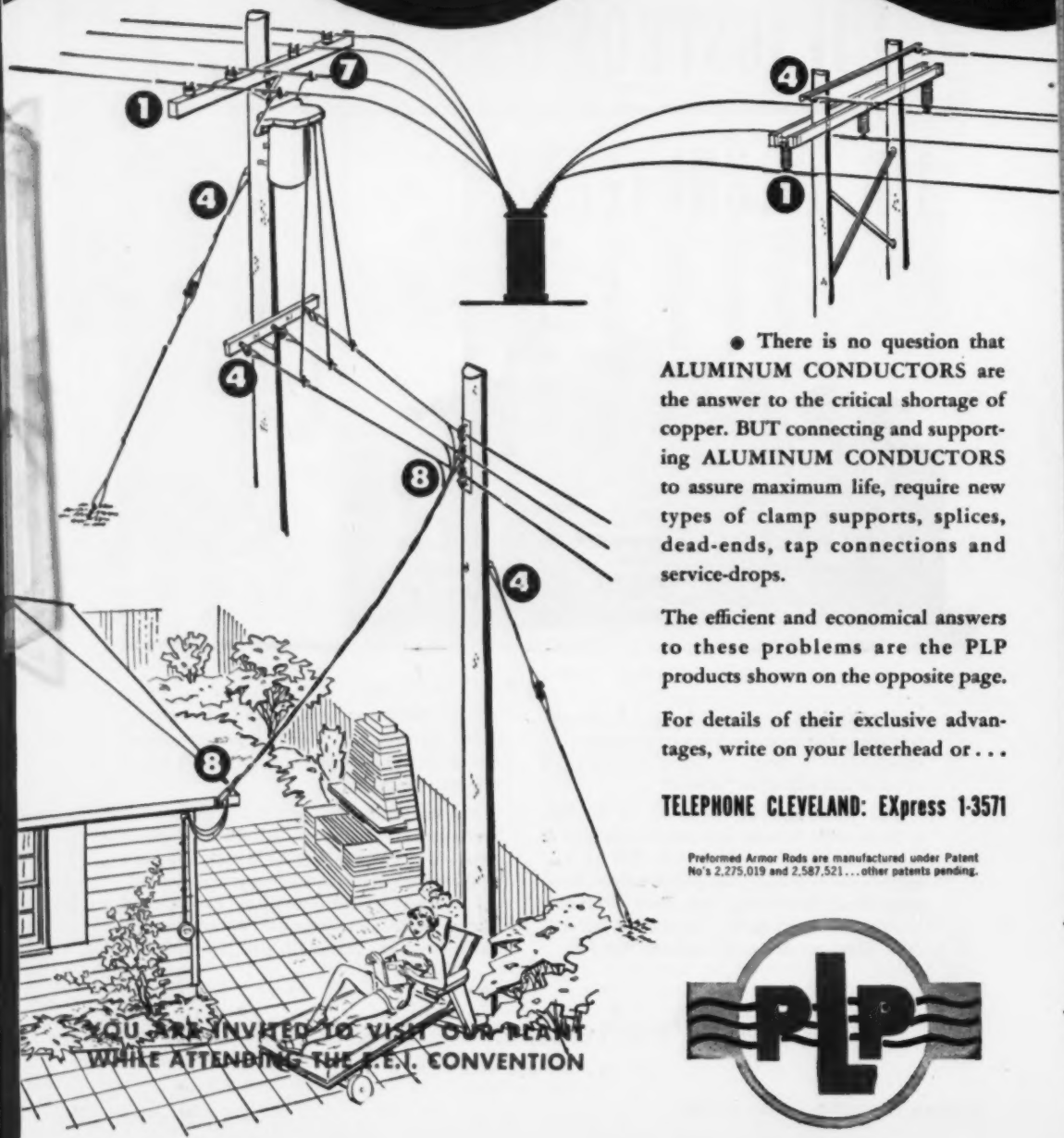
Each Riley unit is supplied with a Ljungstrom Air Preheater, which preheats combustion air to 650 F, cools exit gas to 288 F before it enters the stack.

The unanimity with which Ljungstrom Air Preheaters are chosen for high efficiency steam generating units like these is the best evidence of their high thermal efficiency and dependability. Every boiler manufacturer has included Ljungstrom Air Preheaters in outstanding installations made during the past few years.

THE Air Preheater Corporation

60 E. 42nd St., New York 17, N. Y.

"Preformed" MEANS SAVINGS



● There is no question that ALUMINUM CONDUCTORS are the answer to the critical shortage of copper. BUT connecting and supporting ALUMINUM CONDUCTORS to assure maximum life, require new types of clamp supports, splices, dead-ends, tap connections and service-drops.

The efficient and economical answers to these problems are the PLP products shown on the opposite page.

For details of their exclusive advantages, write on your letterhead or . . .

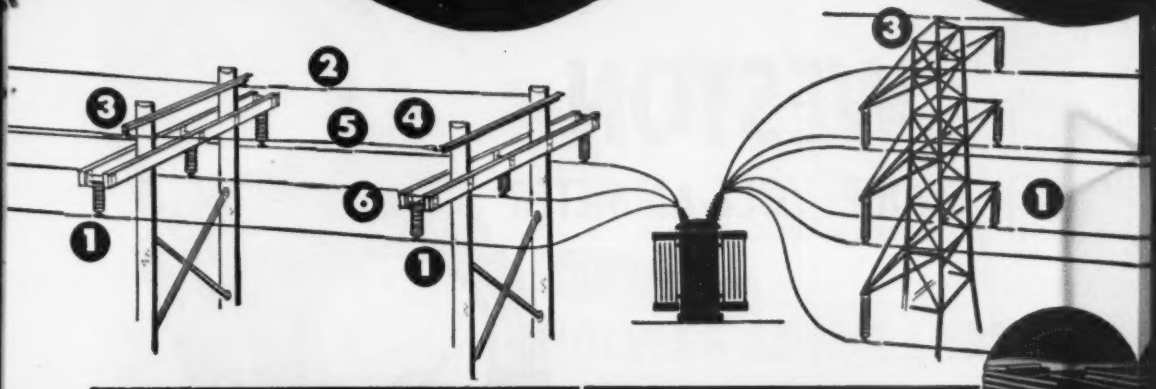
TELEPHONE CLEVELAND: EXpress 1-3571

Preformed Armor Rods are manufactured under Patent No's 2,275,019 and 2,587,521 . . . other patents pending.

YOU ARE INVITED TO VISIT OUR PLANT
WHILE ATTENDING THE A.I.E.E. CONVENTION

PLP

ALL ALONG THE LINE . . . . .

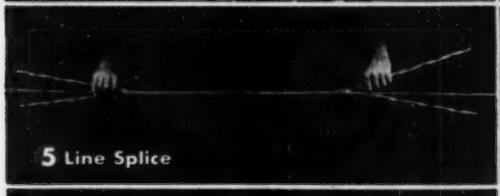


1 Support Armor

2 Repair Armor

3 Strand Armor

4 Dead-End


5 Line Splice

6 Hot-Splice Shunt

7 Hot-Line Tap

8 Service Drop Dead-End

PREFORMED LINE PRODUCTS CO.

5349 ST. CLAIR AVENUE CLEVELAND 3, OHIO

IT PUTS THE SQUEEZE ON MAINTENANCE COSTS!

WESTON MODEL 633
CLAMP VOLT-AMMETER

A-C Current—five full scale ranges of 1000/250/100/25/10 amperes, with range overlap for good readability. Measurements under 10 amperes readily obtained.

A-C Voltage—three self-contained ranges of 700/350/175 volts insure accurate readability, in the upper half of the scale. Instrument insulated for 750 volt service.

Isolated Voltage and Current—with circuits insulated from each other, instrument can be connected to both voltage and current sources at same time.

Convenient 6 position switch—easily operated with gloved hand, a flick of the thumb selects any of the 5 current ranges, or the Volts position.

Adjustable pointer stop—red stop facilitates measuring starting current of motors.

Here's the instrument that produces big savings by slicing hours off maintenance schedules . . . produces worth-while revenue by forestalling costly repairs and shutdowns. Being so quick and simple to use, scheduled maintenance measurements are made more accurately . . . and trouble-shooting is simple and sure. Built to WESTON standards of safety, accuracy and dependability. Also available for A-C Ampere measurement only. Order through your local representative, or write . . . WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey . . . *manufacturers of Weston and Tagliabue instruments.*

WESTON TAG

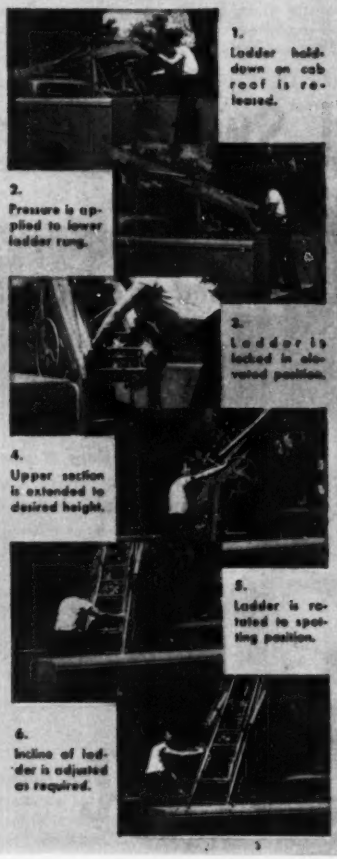
WESTON *Instruments*

9238

. . . TO INDICATE—RECORD—CONTROL

THIRTY FEET HIGH in THIRTY SECONDS

Simple, Easy, One-Man Operation



POWERS *American* SERIES 5510

REVOLVING AERIAL LADDER

Sounds unbelievable . . . but the *Powers-American* Aerial Ladder is so simple, so fast, and so easy to operate that it can be raised to a working position in only 30 seconds—by *one man!* This versatile ladder can be spotted in 40 positions throughout a 360° revolution . . . inclined to any angle from 30 to 75 degrees. Its curved platform falls into position automatically—to provide a level working surface. What's more, this ladder is so safe that it will support *five* times the normal working load. If your operation calls for overhead work, get all the facts on *Powers-American* Aerial Ladders. Mail the coupon NOW for complete information.

POWERS *American* DIVISION

PUBLIC UTILITY BODIES AND EQUIPMENT
McCABE-POWERS AUTO BODY COMPANY
HOME OFFICE: 5900 N. Broadway, St. Louis 15, Mo.
WESTERN OFFICE: Latham Square Building, Oakland 12, Calif.

CLIP THIS COUPON AND ATTACH TO YOUR LETTERHEAD

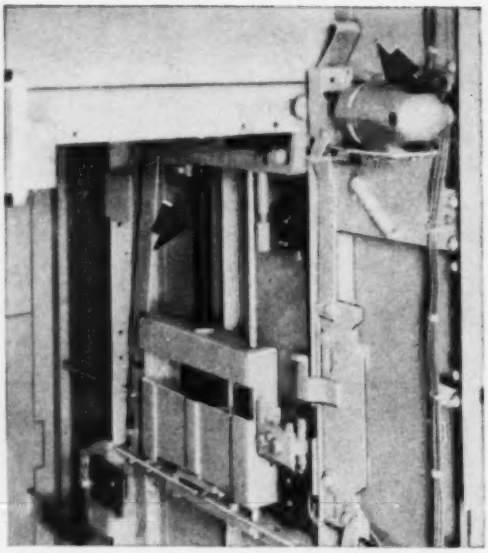
McCABE-POWERS AUTO BODY COMPANY • 5900 N. Broadway • St. Louis 15, Mo.
Please send me details on the following:

SERIES 5510 REVOLVING AERIAL LADDER ( ) 25' 6" ( ) 35' 6" ( ) 50' 6"

- ☐ Line Construction Bodies
- ☐ General Service Bodies
- ☐ Light Duty Maintenance Bodies
- ☐ Wire Reels
- ☐ Pole Trailers
- ☐ Hydraulic Towers
- ☐ _____
- ☐ _____
- ☐ _____

Name _____
Company _____
Address _____
City _____ Zone _____ State _____

REMOVABLE MAGNE-BLAST CIRCUIT BREAKER features improved flame-retardant insulation and simplified contact design. Breaker operating mechanism and control relay are on the front of breaker for easy accessibility.



NEW FASTER ACTING BREAKER ELEVATING MECHANISM can raise the removable circuit breaker into position, or lower it for testing, in 30 seconds. A new compact gear-motor drives the simplified jack screw elevating mechanism.

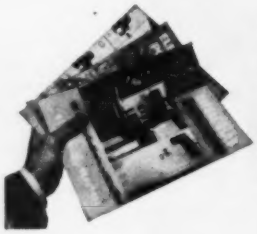
Improved G-E Metal-clad Switchgear

- - - - - - - STRONGER! SAFER! matched to today's demands for more dependable power for increased production

With fast-moving production schedules calling for more and more electric power, General Electric's improved Metal-clad Switchgear, in 4.16 kv and 13.8 kv ratings, answers the need for even greater power circuit protection and freedom from electrical shut-downs.

Retaining all the basic advantages pioneered in earlier G-E Metal-clad Switchgear and meeting all industry standards, this improved equipment offers a wealth of pace-setting design refinements. New features simplify operation and inspection and provide increased safety for personnel. And with stronger, more rigid construction and simplified design of many components, you get even more dependability.

Look over the typical improvements shown here. Then get the complete story from your local G-E Apparatus Sales Office, or write to General Electric Company, Schenectady 5, N. Y.

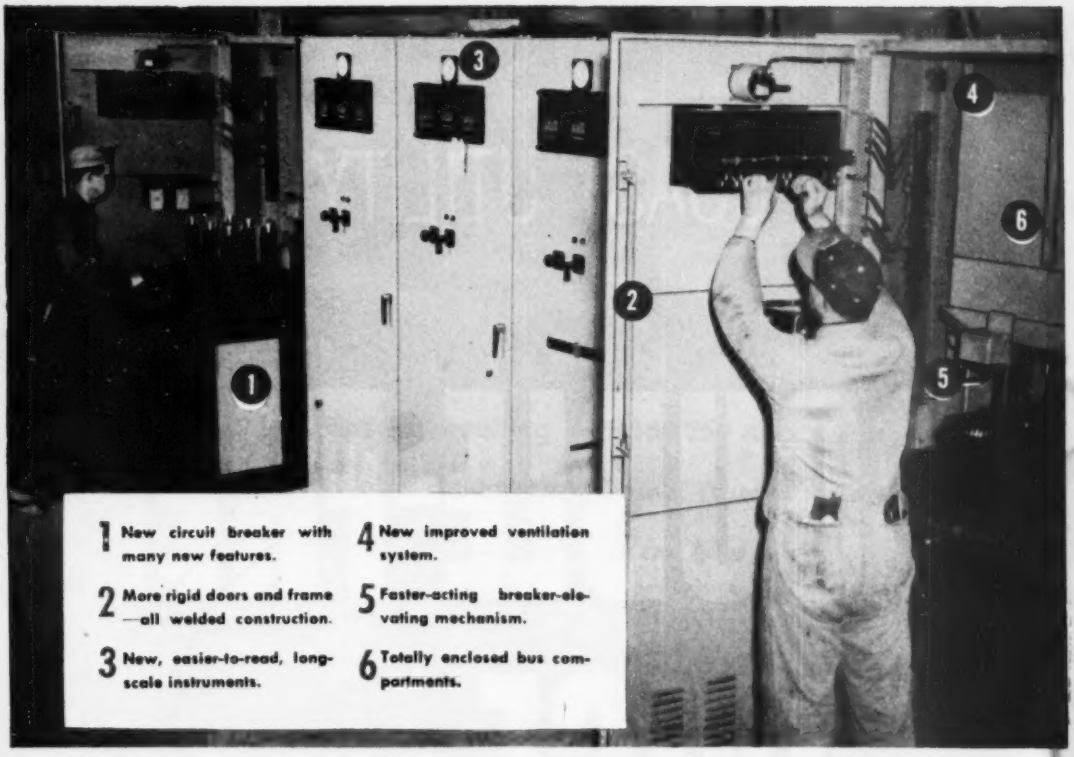


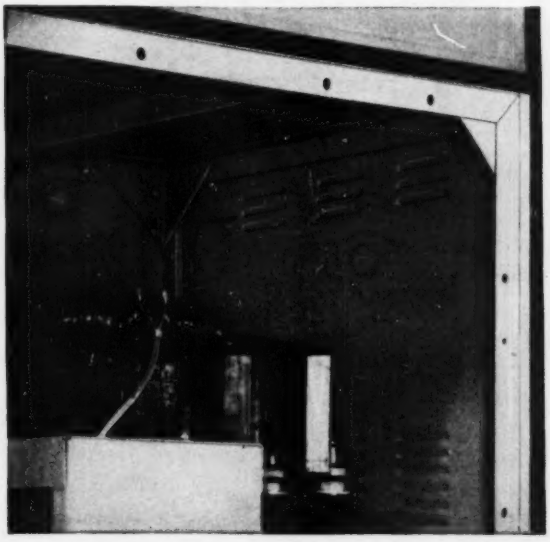
Complete data at your fingertips. Write for these helpful bulletins

Full information on modernizing or expanding your electrical system with G-E packaged equipment is given in these three illustrated booklets. Write for GEA-5664 "G-E Metal-clad Switchgear," GEA-3592 "Load-center Unit Substations," and GEA-5600 "Power for Industry's Third and Biggest Expansion."

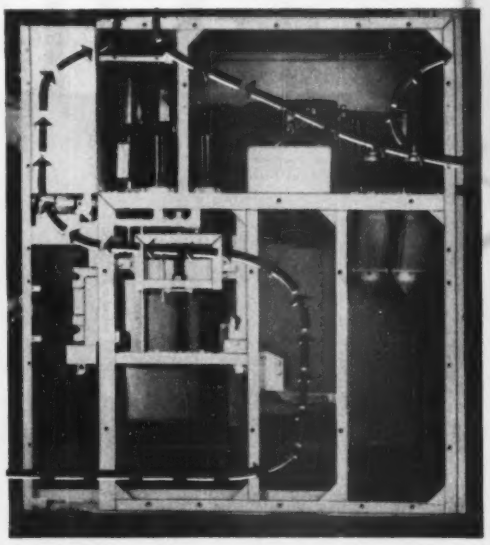
GENERAL ELECTRIC

934-45


1 New circuit breaker with many new features.
2 More rigid doors and frame —all welded construction.
3 New, easier-to-read, long-scale instruments.
4 New improved ventilation system.
5 Faster-acting breaker-elevating mechanism.
6 Totally enclosed bus compartments.



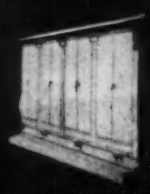
FRAME NOW COMPLETELY WELDED into one solid unit. Gusseted corners (see arrow) provide greater rigidity. Doors have a three-point latch operated from a single handle, and are reinforced against warping by a steel tube at hinge side.



IMPROVED VENTILATING SYSTEM: Arrows show natural draft of air that constantly ventilates entire switchgear unit. The totally enclosed bus compartment, at upper left, is cooled by circulation of air around it.

WEST-COAST UTILITY *reports:*

TROUBLE-FREE SERVICE



FROM ITS C-D CAPACITOR INSTALLATIONS
TOTALLING OVER 155,250 KVAR

Here's another verified C-D field performance record. A large western utility ordered its first C-D capacitors for power-factor improvement back in 1938, and followed this up with many additional C-D installations, totalling over 155,250 Kvar. This utility now reports that these C-D units have given trouble-free service in the field, year after year, with little or no maintenance required. A real tribute to the rugged, money-saving dependability of C-D capacitors!

HERE'S HOW DEPENDABLE SERVICE IS BUILT INTO C-D CAPACITORS:

- Lowest dielectric unit stress
- Highest major insulation level
- Case SAND-BLASTED before spraying, for longer-lasting finish
- Dykanol-filled bushing increases accepted flash-over safety factor
- Lowest volt-amperes per square inch of radiating surface
- Removable solderless connectors
- Many small sections; extremely low voltage gradient per section
- Impregnated and submerged in non-inflammable, non-explosive Dykanol. Results in lower unit weight per Kvar; high stability and longer life

A C-D field engineer will be glad to discuss your power-factor capacitor requirements. Write today for catalog of C-D industrial, station and pole-type capacitors. Cornell-Dubilier Electric Corp., Dept. D-52B South Plainfield, N. J.

CONSISTENTLY DEPENDABLE

CORNELL-DUBILIER CAPACITORS

PLANTS IN: SOUTH PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER, CAMBRIDGE, MASS.; PROVIDENCE, R. I.; INDIANAPOLIS, IND.; FUQUAY SPRINGS, N. C. AND SUBSIDIARY: THE RADIART CORP., CLEVELAND, OHIO

Due to current shortages, it is difficult to build enough new reels to alleviate the present situation. So your immediate help and that of others in your organization, is solicited in returning—as soon as possible—all empty Kerite reels in first class condition.
This cooperation will contribute importantly to maintaining traditional Kerite service under today's harassing conditions.
Thanks for prompt action. Return address:
The Kerite Company, Seymour, Conn.

DAYS KERITE

KERITE CABLE Kerite Insulation—Your Cable's Best Life Insurance

Reaching New Goals

This year America's production of goods and services (Gross National Product) will be about $340 billion. Physical production as measured by the Federal Reserve Board Index of Industrial Production will probably average 225 (1935-1939 = 100). Both of these measures of our economic activity are at very high levels. But even under these conditions we are not using all of our conutry's human resources and productive capacity.

In Electrical World's annual forecast for the next ten years, presented in this issue, we envision a probable Gross National Product of $380 billion and an Industrial Index of 260 by 1961. This probable growth in business activity, stimulated by a 20 million increase in population, can have a dynamic effect upon the electrical industry. Conservative forecasts of what this will mean in terms of the use of electricity show 1961 sales of 700 billion kwhr, 116% above 1951. And should our economic activity reach the potential levels of a $420 billion GNP and a 290 Industrial Index representing full use of productive facilities, electrical energy sales would grow twice as fast.

Obviously in forecasting more than a 100% increase in electric energy sales in ten years, we are presuming a great deal of attention to sales promotion activity. And a far greater effort must be expended if the excess industrial capacity which we are now accumulating is to be required for productive purposes in the years ahead.

On the other hand, we are not closing our eyes to a possible reduction in industrial activity. Nor are we oblivious to the outlook for a recession during the next two or three years. In fact, we are predicting one. Our predictions for 1955 show a probable Gross National Product of $325 billion compared with $340 billion in 1952 and an Industrial Index of 205 compared with 225. But no one in the electrical industry need become alarmed. For most authorities believe this period will still be one of continued healthy growth for our segment of the economy.

We believe that even under these conditions sales of electricity will be up 50% in the next five years. Today when industrial output is leveling out and appliance sales are low, the industry is showing steady gains of around 7% over last year To provide for this growth along with the current backlog of system facilities and adequate reserves, the full 31 million kw now planned for the next three years must be installed. With this must be added the corresponding transmission and distribution facilities. By the time this is done readjustments in our economy should have been completed. Then a new cycle of growth will be facing the industry.

But there is a broader significance to this picture than the mere safety of one industrial group. We must recognize the fact that the electrical industry has now become so important to the economy that its actions can materially affect the overall outlook. The expansion of electrical utility systems represents almost 15% of all business capital expenditures. Add to this the ambitious plans of electrical manufacturers, and we reach about 20% of the total. The sales activities of utilities, manufacturers, wholesalers, and dealers are another important influence upon the American economy.

Obviously the leadership shown by the electrical industry might be decisive in guiding our country's development. Therefore, let us throw all of our weight in the direction of maintaining all industrial activity. Let us also set our sights on reaching new goals through use of America's expanded productive facilities.

Improved Distribution Protection

Distribution circuit protection has progressed in technology pretty well in step with the demands created by the changing pattern and scope of the distribution systems themselves. It has been possible to contend with the shortening of feeders in conjunction with the use of a steadily increasing number of new substations and the resulting increasing of minimum short circuit capabilities.

This increase admittedly eases the task of handling across-the-line starting of motors. It also aids in reestablishing service after a prolonged interruption because the fusing and/or relay settings are necessarily heavier. But in some cases the problem of protection against faults, handling motor loads, and load pickup after prolonged outage will continue to be difficult. This condition arises if the minimum short circuit capability is low and comparable in magnitude to the feeder load, such as long (e.g. rural) lines. Meanwhile the high capacity, oil circuit recloser is providing an economic and satisfactory method of protecting the shorter, higher short circuit capability feeders in contiguous suburban territory. The recloser can clear temporary faults and permit sectionalizing fuses to take care of permanent ones.

There are some who feel that more could perhaps be achieved in the desired protection if the protective device(s) were extended and conceived to:

1. Sectionalize the feeder in the event the main breaker locks out.
2. Be sensitive to fault currents beyond it.
3. Remain open if such faults exist permanently.
4. Reclose an interval of time after the main breaker has been reclosed provided no fault exists beyond its own location.

These are the words in which C. M. Lytle, Kansas City Power & Light Co, defines the capability of a device for automatic pickup of feeder load after it has been interrupted. Naturally, it is going to command more acceptance if it is simple, rugged, and relatively low in cost. Naturally also its characteristics should be adjustable to meet the changes in system needs such as may be required with the increased use of aerial cable. This adjustability may have to conform to individual system preferences regarding aerial cable faults—minimum to save the cable or enough more to burn clear and thus provide identification for easy fault location. But the effort should be made to secure this improved distribution protection.

Preferred Standard Transformers

Standardization of distribution and small power transformers is established and a success because the idea is basically sound. It's time to move on, to look for an area in the power transformer field where similar standardization would be profitable. Main power transformers for generating stations offer such a profitable area for the next step in standardization. It should be considered. Here's why:

1. This is an area where transformer requirements are often duplicated; so the opportunity for standardization prevails.
2. Users have never been offered a standard unit in this range. Selection of ratings has been appropriately whimsical. So the climate is favorable for such a step.
3. Preferred standard turbine generators have been established since 1945 and been thoroughly accepted by the industry. It's logical to expect that if standard turbine generators, with their many variables, can be well received, standard transformers to be used with such units should be equally popular.

The choice of the standard transformer size for use with 30,000, 40,000, 60,000 and 90,000-kw preferred standard turbine generators depends on the interpretation given to the various ratings. It depends also on the intended loadings of the boiler, turbine, generator, and transformer in service. But since the investment in transformer capacity is low relative to that in steam generating equipment and turbine generators, conservatism in the choice of main power transformer size does not appear to be good judgment.

Logic suggests that standard transformer kva ratings be based on the maximum capabilities of the generator. Today practically all steam turbine-driven generators 15,000 kva and over are hydrogen cooled and rated at ½-psi hydrogen with capabilities of 115% at 15-psi hydrogen. It is present good practice to select a transformer kva size in the vicinity of the 15-psi capability of the generator. While a growing number of installations do take auxiliary power from the terminals of the main transformer, the selection of a transformer size on the 15-psi capability basis does result in a rating that matches plant capabilities well.

Inherently, the biggest gains from standardization are achieved in times when material and manpower are at a premium. These conditions prevail today. Thus it's logical to standardize main power transformers for generating stations now. Why wait?

Regulation W Has Been Lifted

Controls on installment buying—Regulation W—have been lifted. Probably some segments of the electric appliance industry are rejoicing. This is the time which they have been anticipating since the controls were first imposed. They see easy credit terms as the answer to their sales problems. Now they think customers will rush into the stores and clean the shelves of appliances so long gathering dust.

Those who put their faith in easy credit as the solution to the problem of selling appliances may find it has brought them only bitter bread. Because the terms of Regulation W—15% down, 18 months to pay—were not the principal, or even an important, reason for buyer lethargy. These terms were not really onerous. They were hardly more than would be required by good business judgement.

It may be that we are wrong in discounting so drastically the effect of lifting controls on installment buying. As respects buyer attitudes, we believe we are right. We believe that customers haven't been buying electrical appliances for this one big reason—They haven't been sold. The many improvements which have been made in appliances make many now in use obsolete. But it takes salesmanship to prove this to the average customer. And it takes salesmanship to put across the many other arguments as to why appliances should be bought now.

Let us hope that the death of Regulation W will signalize the rebirth of selling and that the effect on dealer attitudes will be such as to give the appliance sales a real shot in the arm. Maybe the removal of this fancied obstacle will inspire dealers to pitch in on the selling job they must do.

THE ELECTRICAL WEEK

Featured in the News

NPA-DPA Boss Fowler has some definite ideas about decontrol (p 121) . . . EEI President Gadsby tells PUAA Convention the industry has to develop the personal approach (p 122) . . . Dale E. Doty is confirmed by the Senate as a member of the Federal Power Commission (p 123) . . . FPC has developed a plan to standardize federal power procedures, but it looks as though nothing will be done about it this session (p 124) . . . EEI engineering committees get together to compare notes (p. 125) . . . Fairman warns APPA Convention that slippages are bound to occur (p 127) . . . Future of the electrical industry looks good, convention of National Federation of Financial Analysts Societies is told (p 129).

• • •

Latest from Washington—Bureau of Reclamation has drawn up plans for a $207-million, 218,000-kw project on Trinity River in California . . . AEC is spending about $1 billion a year on its atomic energy program, and the figure will go up to about $1.3 billion a year if its expansion pogram is appoved. AEC says 15 Ohio Valley power companies propose to form a common company or companies to supply the 1.8 million kw of estimated power required for operation of a gaseous diffusion uranium separation plant.

E. Jason Dryer, now serving as Depa general counsel, is slated to be new deputy director of the agency . . . Pacific G&E is asking FPC for a preliminary permit for a proposed hydro project on McCloud River in California . . . House Public Works Committee approves legislation authorizing Army Corps of Engineers to spend $35 million for emergency flood control work, mostly to repair Missouri River levees and other control works damaged by recent floods.

SEC announces that oral argument on Electric Bond & Share Co's "Final Comprehensive Plan" for compliance with Holding Company Act has been postponed from May 12 to May 26.

From Middle Atlantic—West Penn Power Co plans to move its headquarters from Pittsburgh to the Greensburg area.

From West South Central—Abbeville, La., City Council sets a minimum price of $1.5 million on its municipally owned electric system. Mayor J. E. Kibbe declares that Gulf States Utilities had offered $1,012,326, but in his opinion it was far from being sufficient in view of the returns the company will receive on its investment.

From the Far West—Idaho's Attorney General Robert E. Smylie predicts American P&L will distribute Washington Water Power common stock to its stockholders by July 1 and that the concern will be freed of "eastern dominance."

Construction—Yarrows Ltd, Victoria, B. C., will build 41 aluminum transmission towers, to cost more than $800,000, for Aluminum Co of Canada's power line from Kemano to Kitimat on British Columbia's north coast (EW, Jan. 21, p 32).

Financial—Electric Bond & Share will pay June 25 to stock of record May 22 a common dividend payable in common stock of Southern Co at the rate of four shares of Southern Co for each 100 shares of EB&S . . . USBR discloses it will set aside its plans for the power and water storage development on Feather River in California if the State proceeds with its proposal to finance a $1-billion project on the stream through the issuance of revenue bonds (EW, April 28, p 7) . . . Pennsylvania PUC approves consolidation of Scranton Electric Co and the Abington Electric Co.

Labor—Appalachian Electric Power and IBEW agree to 5% wage increase . . . Commonwealth Edison and IBEW agree to 8% wage hike . . . Pennsylvania P&L and independent union settle for a little less than 8% wage boost.

Legislation—Michigan's Gov G. Mennen Williams signs bill which requires notices be given all cities of proposed increases in public utility rates. It prohibits PSC from acting on rate increase petitions until a report is made of the situation by its technical staff . . . Massachusetts House suspends rules to admit a bill to allow Taunton Municipal Lighting Commission to sell electricity in adjoining North Dighton. The bill also will allow the commission to purchase the electric system of Mt. Hope Finishing Co serving that town.

Rates—Nova Scotia Provincial Public Utilities Board takes under consideration application of Seaboard Power Corp for 10.24% rate increase in industrial and domestic classifications . . . PSC grants Georgia Power Co a hearing June 12 to see if there are "extraordinary conditions" to warrant reopening $4.2 million rate increase case.

Hydro Capacity of U. S. central stations now exceeds 19 million kw and internal combustion capacity exceeds 2 million kw. Exact figures on April 1 were steam, 55,380,818 kw; hydro, 19,052,567 kw; internal combustion, 2,001,146 kw; total, 76,434,531 kw.

Lead prices cut, for third time since April 29, to 15¢ a lb, 4¢ below the ceiling level.

Hotpoint, Inc, promotes Vice Pres John Sharp to the presidency succeeding James J. Nance, now president of Packard Motor Car Co. Detroit is asking—Does the move foreshadow Packard's entrance into the appliance field, via merger—Nash-Kelvinator?

Congratulations—Wisconsin Utilities Association elects Theron Brown, vice president and general superintendent of Madison G&E, president; also elects George A. Donald, president of Lake Superior District Power Co, vice president . . . New York City's Hundred Year Association elects Charles B. Delafield, vice president of Consolidated Edison Co, president . . . Vancouver Electrical Association elects John Grumey, Coast Electric Co, president.

WASHINGTON COMMENT

JESSE MOCK

If outward appearances could be relied on, it would seem that Congress is getting the runaround on two small but important appropriation items for electric transmission lines.

The situation is this:

Southeastern and Southwestern Power Administrations —the power marketing twins of the Interior Department— are bent on constructing some 95 miles of transmission line in their marketing areas. As they read the law, it is their responsibility to transmit power from federal projects to preference customers.

Congress, which wrote the law, has a little different idea. In the written reports accompanying funds legislation there is the admonition that these agencies should build transmission lines only as a last resort. First, they should try to make use of existing lines by negotiating "wheeling" contracts with the owners, which are usually electric companies.

One Way to Fool Congress . . . The agencies have worked out a clever procedure which seems to circumvent the directive of Congress.

"Surely you don't expect us to negotiate these contracts with an empty purse," they tell Congress. They then ask for a small initial appropriation to build the lines. Once they get this initial appropriation, they have a "club" with which to threaten the electric companies at negotiating sessions.

Their attitude toward the company is "either you give us exactly the kind of 'wheeling' contract we want, or we build the line ourselves and begin siphoning off your customers." Only companies who have dealt with these agencies know how widely this "club" can be swung.

In the case of Southeastern, the line in question is a 41-mile, 115-kv line from Clark Hill Dam to the Greenwood County (S. C.) Electric Power Commission. Last year the agency was granted $318,500 by Congress to use as a "club" in negotiating a "wheeling" contract with South Carolina Electric & Gas Co. But Congress told the agency these funds were not to be used until "every possible effort" had been made to obtain a "wheeling" contract with the company.

Utility Willing but Sepa Isn't . . . South Carolina Electric & Gas has offered a number of times to sit down and negotiate with Sepa on the Greenwood line. But first the agency wanted to negotiate a system-wide "wheeling" contract. Later, Sepa hinted that the Greenwood County Commission might want to build the line itself.

But when Sepa came to Congress again this year for money, it asked for another $869,500 to build the line. In its justification notes, it listed the line as "under construction." The argument was then made that Congress would be throwing away its previous appropriation unless it allowed the agency enough to continue "construction." In reality the only construction underway was the acquirement of some rights-of-way. Only recently has the contract been let for clearing these.

Thus the "club" which Congress gave Sepa to use on the electric company was brought back to use on Congress, itself.

With slight variations, this same procedure has been used by Southwestern Power Administration in connection with a proposed 54-mile Springfield-to-Carthage, Mo., line. In this case a contract was negotiated by the agency, but it has been gathering dust on the desk of Interior Secretary Oscar L. Chapman since January. Nevertheless, SPA is asking more money from Congress to build the line.

Use of this procedure has moved one observer to say Congress is getting the "ninety-five mile runaround." If so, it has no one to blame but itself. This legislative trick is an old one that Congress uses occasionally for its own purposes.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Total enclosure of conveyors, with negative pressure maintained by exhaust fans, facilitates control of dust, especially at unloading and transfer points.

Joints in high-pressure cables (both oil and gas) showed no failures among 3192 joints in the EEI report for 1948.

Alarms are often desirable but installation of several dozen may result in 15 or 20 going off simultaneously in a major power plant emergency. What do I do first? Better discriminate.

Air holds open a 230-kv, 3-cycle airblast circuit breaker. Pressure is 215 psi. There is no isolator.

Pentachlorophenol in 5% concentration is comparable in toxicity to creosote for pole preservation.

Radio frequency induction heating units in American industrial plants exceed 500,000 kw in aggregate operating capacity and $75,000,000 in investment.

Heavy snow experience teaches these lessons; guy adequately, use top quality poles and line material, use double stop ties on insulators, avoid alley arms or unevenly loaded arms, dead-end wherever possible.

Silicone grease is being used to (a) lubricate and prevent ice formation on disconnect switches, (b) preserve linemen's leather goods, and (c) seal transmission line splices.

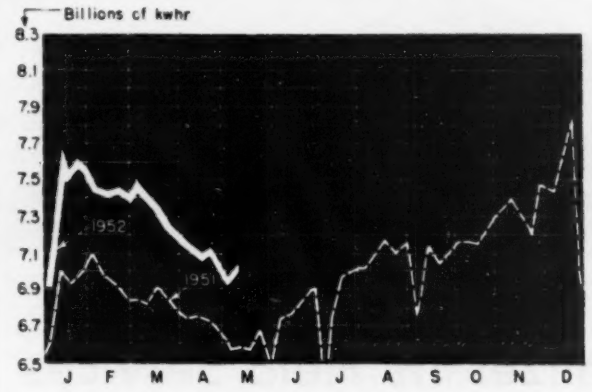
Gas-turbine electric-drive locomotive of 3,500 hp is being put into service on the Great Western between London and Plymouth for 90 mph and extreme grade of 1 in 36.

Spreader stokers are afflicted with growing pains. They are growing larger in feasible ratings. They are growing better in load-range performance. They grow on the auxiliary conscious engineer—roughly one-tenth as much hp as pulverizing requires.

Publicizing of operating errors is bad for morale. Dissemination of the salient facts is good for the cause.

Broom-wielders have been known to jar low-mounted relays into contact resulting in an unwanted tripping that is hard to analyze and explain.

STATISTICS



Output Week Ended May 10—7,030,000,000* Kwhr

Per Cent Change From Previous Year

	Total US	New Eng.	Mid. Atlan.	Cent. Ind.	West Cent.	South-east	South Cent.	Rocky Mount.	Pacific NW	Pacific SW
May 10	+7.1*	(Data on regional change not available at press time)								
May 3	+5.9	+4.8	+5.1	+0.6	+5.1	+12.0	+12.5	+1.7	+4.7	+8.5
April 26	+6.9	+3.5	+6.0	+4.2	+5.5	+13.5	+16.3	+4.1	+4.1	+3.1

Electric Power Statistics

		Latest Month	Preceding Month	Year Ago
Peak Load (Million Kw)	Feb.	64.8*	69.0	62.4
Capacity (Million Kw)	Mar.	76.34	75.99	70.25
Production (Billion Kwhr)	Mar.	33.04	31.54	30.92
Hydro		10.44	9.46	9.22
Fuel		22.60	22.07	21.70
Fuel Consumption				
Coal (Million Tons)	Mar.	8.84	8.74	9.03
Oil (Million Barrels)		5.22	4.77	5.53
Gas (Billion Cu Ft)		57.39	54.82	48.48
Sales (Billion Kwhr)	Feb.	29.08	29.72	26.50
Residential		8.51	8.87	7.58
Commercial		4.87	4.99	4.89
Industrial		13.82	13.90	12.64
Other		1.88	1.95	1.79
Net Income Class A & B Companies ($ Million)	Feb.	88.00	86.59	80.33
Estimated Dec. 52 Peak (Million Kw)*	Feb.	80.5	80.6	78.0
Kwhr per Residential Customer (12 Month Average)	Feb.	2,037	2,021	1,867
Revenue per Kwhr Residential Service (12 Month Average)	Feb.	2.80¢	2.81¢	2.86¢
Canadian Production (Billion Kwhr)	Feb.	4.97	5.27	4.38

Business Statistics

FRB Industrial Production Index†††	Mar.	217*	218	219
Gross National Product Annual Rate ($ Billion)	1st Qtr.	339.0*	334.6	319.5
E. W. 5 Industry Production Index	Apr.	124.0*	123.8	122.6
ENR Construction Cost Index††	May	116.8	116.2	113.6
BLS Consumer's Price Index	Mar.	188.0	187.9	184.5
NEMA Insulation Materials, Sales Index†	Feb.	528	548	552
NEMA Electric Appliance Sales Index†	Feb.	224	233	343
NEMA Household Refrig. Sales Index†	Feb.	153	153	238
Metal Prices (May 13)				
Copper, Conn. V., lb		$ .24½	$ .24½	$ .24½
Lead, N. Y., lb		.15	.19	.17
Zinc, prime Western E. St. Louis, lb		.19½	.19½	.17½
Tin, Straits, qual. N. Y., lb		1.21½	1.21½	1.39
Aluminum, ingot, base price		.19	.19	.19
Nickel, base price		.56½	.56½	.50½
Steel, billets, Pitts., ton		56.00	56.00	56.00
Steel, scrap, No. 1 heavy, Pitts., ton		45.00	45.00	45.00

* Estimated. † 1936=100 †† 1949=100 ††† 1937-39=100 (Unadjusted)

Electric Utility Depreciation Practices

A continuing trend toward general adoption of straight line depreciation accounting practices by the privately-owned electric utilities has been reported by the Federal Power Commission.

According to the FPC study, 76% of the Class A and B companies are now using the straight line method compared with 52% in 1945 and 15% in 1937. An increasing number of utilities are, also, segregating electric plant accounts, depreciation reserve accounts, and depreciation expense accounts. Over one-third of these utilities report annual rates of depreciation by property accounts and have established reserves by functional classes of property.

The report shows that these 298 companies have, on the average, a depreciation reserve that is 20.5% of total utility plant, and an annual depreciation expense that is 2.25% of total utility plant. These figures are based on plant accounts at the end of 1950.

Depreciation Reserves
Class A & B Electric Companies

Total Utility Plant (Billions of Dollars)	Depreciation Reserves (Billions of Dollars)	Depreciation Reserves (% of Plant)
1950 .... $21.4	4.4	20.5
1949 .... 19.6	4.1	20.7
1948 .... 17.8	3.9	21.7
1947 .... 16.0	3.6	22.3
1946 .... 15.0	3.3	22.3
1945 .... 14.5	3.1	21.2
1944 .... 14.8	2.8	19.1
1943 .... 14.8	2.6	17.2
1942 .... 14.8	2.3	15.5
1941 .... 14.7	2.1	14.2
1940 .... 14.4	1.9	13.3
1939 .... 14.1	1.8	12.5
1938 .... 14.0	1.6	11.6
1937 .... 13.9	1.5	10.8

Depreciation reserve ratios reflect the effect of factors which change the average age or service life of electric plant. During the present era of marked expansion the average age of utility properties has been significantly reduced. Increases in plant relative to reserves has resulted in a decline in the reserve ratio.

During 1947-1950 electric plant investment increased some 10% annually. Average increase during the preceding nine years was slightly less than 3%. Consequently depreciation reserves, as a percentage of total utility plant, have fallen off.

NEW SERVICE CENTER of Quebec Hydro-Electric Commission centralizes the commission's field services. The building, which measures 720 ft by 600 ft, is largely one story high but has a limited second-floor section for offices, training schools, and an auditorium

Quebec Centralizes Its Field Services

MAIN ENTRANCE of service center is faced with smooth-polished rouge-colored granite

PLAQUE in entrance hall of the center is unveiled by Premier Duplessis of Quebec

Quebec Hydro-Electric Commission last month opened a new service center in Montreal which centralizes its field services under one roof.

The commission had been using a number of buildings, some of them dating back to 1847, for these operations and had to store its supplies and equipment in widely separated parts of Montreal.

The ground floor of the new center has been planned to accomodate the commission's garage, general shops and stores, gas and electric meter shops, and government quarters for meter inspection. The garage has the equipment necessary for complete overhaul of vehicles, except for engine rebuilding.

The center, begun in November 1949, was inaugurated April 19 by Quebec Premier Maurice Duplessis.

CAR WASHING facilities are part of the center's garage section. Travelling frame with perforated floor accomplishes clean-up job

FORK LIFT TRUCKS which have been equipped with pallets are used to permit rapid and easy handling of heavy parts and equipment

Controls Are Entering the Final Phase

- **Henry H. Fowler, who succeeds Fleischmann, favors rapid relaxation of controls but won't be rushed into decontrol**
- **Depa feels some priority still is needed by the power industry if three-year goal of 31 million kw is to be met**
- **New DPA boss wants to keep a finger on production of metals so the military will have enough for weapons**

The change of guard at the Defense Production Administration means that production and construction controls are nearing their final phase.

Henry H. Fowler, who succeeds Manly Fleischmann as DPA boss June 1, has been working on decontrol plans for the last several weeks. It was Fowler who drew up the detailed schedule for gradual removal of materials controls between now and early 1954 for Fleischmann.

Won't Be Rushed . . . But, though he believes strongly that controls should be relaxed as rapidly as possible, Fowler isn't going to be hurried into decontrol.

He has already vetoed a proposal by the steel industry that it be allowed to call the turn on decontrol of various shapes and forms of steel over the next several months. Fowler believes allotment of steel for civilian uses can be dropped gradually over the next six-nine months, but DPA will set the timing.

Fowler feels that the Controlled Materials Plan in its present form—with allotments of steel, copper, and aluminum for all major users—must be retained at least until next year. While supplies of metal, especially steel and aluminum, are increasing, there won't be enough before next year to allow a scramble among all users for what is available. Too many vital industries might get caught short.

Still plagued by threatened and actual shortages of equipment, the mobilization officials in charge of electric power also want to go easy on decontrol.

Defense Electric Power Administrator James F. Fairman believes some priority must be maintained for the power industry if it is to meet its three-year, 31 million-kw goal. He talks of the period of rapid decontrol of materials as still some distance away.

Subject Aired . . . The subject has been aired thoroughly by the electric power coordinating committee of which Fairman is chairman, and which also consists of a top representative from both National Production Authority and DPA. It remains to be seen whether electric utilities will retain some priority during the period of general decontrol.

At the operating level of Depa there are signs of control relaxation. This is brought about partly by the increasing availability of materials and the smoother operation of CMP. Straws in the wind at the agency thus far are:

- A study to determine how much paper work can be eliminated in dealing with utilities on material control matters.
- A reduction in force of the construction-expediting branch brought on by less need for procurement assistance.
- Generally less pressure on the operating personnel of Depa now that material allotments have eased.

Even after it becomes safe to allow a scramble among non-defense users of metal—probably by Jan. 1—DPA boss Fowler wants to keep a finger on metal production. That's one reason why he plans to continue CMP type of allotments for military production throughout 1953. That will require producers of steel, copper, and aluminum to continue clearing their schedules in advance with the government. Thus Washington can be sure the mills will be turning out metal in the shapes and forms needed for the production of weapons.

Arms Procurement . . . Fowler also wants to keep a firm hand on arms procurement. Likely cuts in military spending mean the armed forces must settle for fewer weapons or find ways to get more for their money. Fowler thinks a strong DPA, manned by industry people with the proper know-how in production techniques, can help the military to get more efficiency in procurement.

HENRY H. FOWLER

The new DPA chief probably will be in an even stronger position than his predecessor to put his ideas into effect. It's now clear that the top controls job—that of Director of Mobilization vacated a month ago by Charles E. Wilson—will not be filled permanently in the near future. Acting Mobilizer John R. Steelman, who is no production expert, probably will let Fowler write his own ticket on materials controls and defense production policy.

In addition, Fowler will retain his job as administrator of NPA, a post he has held since last Jan. 8. So he will have the last word on both policy-making at the DPA level and on NPA's administration of his policies.

His Deputies . . . He plans to name potent deputies in both agencies to take most of the administrative details off his hands. Franz Stone, already the deputy administrator of NPA, probably will take over most of Fowler's chores there. DPA has several deputy administrators. Ralph S. Trigg, James F. King and William L. Campbell rate as the most able, and one of them probably will be selected as Fowler's top DPA aide.

AD DISPLAY was a magnet for the ad-men. Above, Gerald T. Clifford, Penelec, runs across Ernest R. Laws, Philadelphia Electric

PUAA BETTER COPY CONTEST entries attracted attention of Allen F. Stadler, Ohio Edison Co's general supervisor of advertising

To make the ads count, Gadsby tells PUAA, utility advertisers must remember . . .

It's The People Who Will Decide

The electrical industry has got to start thinking about what the people want, rather than just about what it wants, if it hopes to continue as an independent force in this country, George M. Gadsby, president of Edison Electric Institute, said last week.

Gadsby, who is also president of Utah Power & Light Co, spoke to delegates to the 31st Annual Convention of the Public Utilities Advertising Association in Minneapolis.

"It is the people who will decide," he said. "If they want public power, they will have it. If we can show them it is to their own interest to have us, they will have us."

Gadsby said it was in the field of advertising men to accomplish this.

The Mistakes . . . Once, he said, there was an era of good feeling about private power, but back around the '20's, the industry lost its standing. Financial pyramiding and collapse of the holding companies started the downtrend, he pointed out. Delays and impolitic procedures in rural electrification accelerated the process, he said.

"There never would have been the need," he said, "for rural electric cooperatives—and there was a need for them—if private utilities had had more faith in themselves to develop the farm market."

The electric companies, Gadsby said, failed to approach the farmer as a party at interest in their rural electrification plans. The first the farmer knew anything about it was when agents of the power company asked him for right-of-ways.

"If we'd called the farmers in we could have had a force of friendship in rural areas that would have protected us from anything that came along," he said.

And more . . . A third thing that has hurt the industry, he said, is its inability to make the personal approach in dealing with people.

"We are learning now to see what the other fellow has in mind," he commented. "We've got to approach the public on a 'What is good for you?' basis."

Selfish viewpoints, lack of unity in the industry and inadequate advertising and public information appropriations are other reasons for the industry's status, he said.

"All these things," he commented, "made us ripe for an invasion. Our own record and shortcomings made it possible for the Washington public power crowd to incite public opinion against us. Santa Claus and a spigot in the U. S. treasury are indeed tough competition."

The Remedy . . . Remnants of the industry's faults still exist, he asserted, but gradually they are being worn down. Proper advertising and public relations approach to the problem can do much to wipe out a negative feeling on the part of the public toward the industry, he added.

PUAA Awards Made

Public Utilities Advertising Association announced the winners of its 1952 Better Copy Contest at its annual convention at Minneapolis last week.

In most classifications, entries were judged in three national groups based on the number of meters in service. Group A included utilities with 400,000 or more meters; B, more than 150,000 and less than 400,000; and C, less than 150,000.

Unless otherwise stated the companies listed in each group were winners of first, second, and third awards respectively. Only awards won by electric or combination companies are listed.

Complete programs—A: Duquesne Light Co, second; Cincinnati G&E Co, third; B: Public Service Co of Oklahoma, first; Wisconsin Public Service Corp, second; C: Hawaiian Electric Co, Hartford Electric Light Co, Central Arizona L&P Co.

Series of three to five newspaper ads on a public relations subject—A: Cincin-

nati G&E Co, first; Philadelphia Electric Co, second; B: Wisconsin Public Service Corp, first; Puget Sound P&L Co, third; C: Hawaiian Electric Co, first; Iowa Electric L&P Co, third.

Single newspaper ad on any subject—A: Consolidated Edison Co of New York, second; Northern States Power, third; B: Public Service Co of Oklahoma, first; Dayton P&L Co, third; C: Central Hudson G&E Corp, Southwestern Public Service Co, Hawaiian Electric Co.

Single newspaper ad promoting the use of electricity—A: Cleveland Electric Illuminating Co, Public Service Co of Northern Illinois, Public Service E&G Co; B: Dallas P&L Co, Central P&L Co, British Columbia Electric Co; C: West Texas Utilities Co, Hawaiian Electric Co, Central Illinois E&G Co and Eastern Shore Public Service Co, tied for third.

Single newspaper selling electric merchandise—A: Boston Edison Co, New York State E&G Corp, Philadelphia Electric Co; B: Narragansett Electric Co, Kansas City P&L Co, Columbus & Southern Ohio Electric Co; C: West Texas Utilities Co, Potomac Edison Co, St. Joseph P&L Co.

Employee magazines—A: Detroit Edison Co, first; Philadelphia Electric Co, third; B: Metropolitan Edison Co, first; Dayton P&L Co, second; C: Hartford Electric Light Co, first; Washington Water Power Co, third.

Special booklets, pamphlets, and literature other than house organs sent to employees—A: Detroit Edison Co, Consolidated Edison Co of New York, Pennsylvania P&L Co; B: Kansas City P&L Co, Utah P&L Co, New Orleans Public Service Co; C: Washington Water Power Co, Hartford Electric Light Co, Central Arizona P&L Co.

Window display—A: Union Electric Co of Missouri, Consumers Power Co, Philadelphia Electric Co; B: Kansas P&L Co, second; C: Empire District Co, Potomac Edison Co, Delaware P&L Co.

Interior displays—A: Cincinnati G&E Co, New York State E&G Corp, Commonwealth Edison Co; B: New Orleans Public Service, first; Metropolitan Edison Co, third; C: Wisconsin Electric Power Co (Extension System), first.

Car and bus cards and truck posters—A: Pacific G&E Co, second; Consolidated Gas Electric Light & Power Co, third; B: New Orleans Public Service Co, third; C: Hartford Electric Light Co, second; Winnipeg Electric Co, third.

Outdoor advertising—A: Public Service Co of Northern Illinois, Pacific G&E Co, Consolidated Gas Electric Light & Power Co; B: Kansas City P&L Co, first; Dayton P&L Co, third; C: Hartford Electric Light, second; Winnipeg Electric Co, third.

Annual report to stockholders—A: Pennsylvania P&L Co, Union Electric Co of Missouri, Puget Sound P&L Co; B: Florida P&L Co, Dayton P&L Co, San Diego G&E Co; C: Iowa P&L Co, Southwestern Public Service Co, Iowa Electric L&P Co.

Employee newspapers—A: Consumers Power Co, first; Georgia Power Co, second B: Texas Electric Service Co, West Penn Power Co, Ohio Power Co; C: Central Hudson G&E Corp, Central Arizona L&P Co, Potomac Edison Co.

Series of bill enclosures, postcard billing cards, direct mail pieces and other material sent to residential, farm, commercial, or industrial customers—A: Georgia Power Co, first; Boston Edison Co, third; B: New Orleans Public Service Co, Texas Electric Service Co, Connecticut L&P Co; C: Public Service Co of Colorado, Potomac Edison Co, Central Hudson G&E Corp.

Single booklet, pamphlet, or other piece sent to residential, farm, commercial, or industrial customers—A: Detroit Edison Co, Public Service Co of Northern Illinois, Pennsylvania P&L Co, B: British Columbia Electric Co, Kansas P&L Co, Florida P&L Co; C: Central Hudson G&E Corp, second.

Printed material used in dealer promotion on any subject—A: Philadelphia Electric Co, first; B: New Orleans Public Service Co, Utah P&L Co, Florida Power Corp; C: Southwestern Public Service Co, first; Central Hudson G&E Corp, second.

* **Radio advertising**—Union Electric Co of Missouri, first; Duquesne Light Co, second.

* **Motion pictures**—Pennsylvania Water & Power Co first; Southwestern G&E Co, second; Consumers Power Co and Pacific G&E tied for third.

* **Television**—Consolidated Edison Co of New York, second; Cincinnati G&E Co, third.

* All compete as one group.

Doty Confirmed for FPC Post

Former Assistant Secretary of Interior tells Senate Committee private and public power can live together

With full backing from the Senate, Dale E. Doty last week took over as Federal Power Commissioner. Confirmation of the former Assistant Secretary of the Interior filled the vacancy on the five-man group created last October by the resignation of Mon C. Wallgren.

Not a dissenting vote was cast against Doty's confirmation, either in the Senate or in the committee which considered it, despite the fact that it had been delayed for nearly three months.

Not Committed to Public Power . . . At a final hearing just before his confirmation, Doty told the Senate Committee on Interstate and Foreign Commerce he was not committed to development of public power as against private power.

"I feel we need the power, and all the power we can get no matter who develops it," Doty said. "In this country, the greatest development, in my opinion, is going to be basically private power.

"I have been for the public power program of the Department of Interior and tried to support it, but I am not one who thinks that the two cannot live together and that it has to be a dog and cat fight. We have shown in many ways now that we can live together and both serve the public in developing our power resources."

Committee Chairman Edwin Johnson, Colorado Democrat, then asked, "In other words, you have no disposition to block the development of private power?" Answered Doty, "No, I have not, sir."

Nomination of Chairman Thomas C. Buchanan for a full five-year term on the commission was sent to the Senate last week for confirmation. Buchanan, who became FPC chairman early this year, is serving out a term which expires June 2.

J. A. COLVIN

D. F. KIGAR

Utility Men Fill Mobilization Posts

Two utility men have been granted leave by their companies to serve with mobilization agencies handling power equipment. They are James A. Colvin, Northern States Power Co of Minnesota, who will serve as director of Engine and Turbine Division of National Production Authority; and Donald F. Kigar, Detroit Edison Co, new director of Materials and Equipment Division of Defense Electric Power Administration.

Colvin, manager of power production and system operation for NSP, replaces Otis Howard as ETD director. Howard is returning to Oklahoma Gas & Electric Co, where he is manager of operations.

Kigar, assistant manager of purchases for Detroit Edison, succeeds Donald R. McClung who is resuming his duties with Pacific Power & Light.

FPC Has Plan . . .

. . . for standardizing federal power development, but hopes for legislation this year are dim

Hopes that legislation might be adopted to standardize federal power development procedure are dimmed by the rapidly approaching adjournment date of Congress.

A special House subcommittee on public works that has been studying the problem may recommend legislative action, but there is almost no chance of adoption this year.

Lack of uniformity in federal procedures is shown by the various roles given Federal Power Commission in fixing rates on power from federal projects:

- FPC has no authority to approve rates on power sold from Hoover or Grand Coulee Dams.
- The agency must approve rates on power generated from projects constructed by the Army Corps of Engineers.
- No rate approval is required for power generated from Reclamation Bureau, International Boundary Commission, or Tennessee Valley Authority projects.

FPC Chairman Thomas Buchanan told the committee these steps were necessary to bring about uniformity:

1. Congress should be more definite in laying down the cost allocations, and amortization periods for federal multi-purpose projects so that a fair investment base would exist for rate-making purposes.
2. FPC should be either relieved of or given full responsibility for approving power rates for all federal projects.
3. FPC should be given authority to allocate costs of projects if it is given the rate-making power.
4. In the event FPC is relieved of rate-making for power from federal projects, the commission should make occasional investigations of the power marketing agencies.

Changes in Capacity Reported to FPC

PLANT ADDITIONS DURING FEBRUARY

State	Utility	Plant	Fuel	Capacity (Kw)
Me.	Stratton Light Co.	Eustis	H	250
Me.	Maine Public Service Co.	Caribou	IC	1,000
Conn.	South Norwalk Electric Works	S. Norwalk	IC	1,900
Pa.	Pitcairn Electric Light Department	Pitcairn	IC	360
Pa.	Girard Borough Municipal Light Department	Girard	IC	675
Ohio	Piqua Municipal Power Department	Piqua	S	12,500
Mich.	U. S. Army Corps of Engineers	St. Marys	H	4,800
Iowa	Manilla Service Department	Manilla	IC	485
Iowa	Corn Belt Power Cooperative	Humbolt	S	11,500
Iowa	State Center Light & Power Department	State Center	IC	588
W. Va.	Central Operating Co (American Gas & Electric Co).	Philip Sporn	S	125,000
S. C.	South Carolina Electric & Gas Co.	Hagood	S	40,000
Wyo.	Black Hills Power & Light Co.	Osage No. 2	S	11,500

PLANT RETIREMENTS DURING FEBRUARY

Ohio	Columbus & Southern Ohio Electric Co.	Delaware	S	300
Ind.	Northern Indiana Public Service Co.	Ontario 1	H	150
Ind.	Northern Indiana Public Service Co.	Ontario 2	H	150
Ill.	Rantoul Water & Light Plant	Rantoul	S	300
Ill.	Union Electric Power Co.	Venice 1	S	7,500
Ill.	Public Service Co of Northern Illinois.	Kankakee	H	600
Wis.	Dairyland Power Cooperative	Baldwin	IC	2,500
Iowa	Iowa-Illinois Gas & Electric Co.	Coralville	S	1,000
Iowa	Iowa-Illinois Gas & Electric Co.	Fort Dodge	S	2,000
Mo.	Union Electric Co of Missouri.	Mound	S	3,500
S. D.	Brookings Electric Department	Brookings	S	750
Kan.	Western Light & Telephone Co.	Lebanon	IC	100
Kan.	Western Light & Telephone Co.	Liberal	IC	340
Md.	Consolidated Gas, Electric Light & Power Co of Baltimore	Westport	S	5,000
Fla.	Florida Power Corp.	Tallahassee	IC	750
Wyo.	Utah Power & Light Co.	Evanston	S	250
Colo.	Public Service Co of Colorado.	Lacombe	S	12,500
N. M.	Socorro Electric Cooperative, Inc.	Magdalena	IC	298
Ore.	Pacific Power & Light Co.	Hermiston	H	150
Wash.	Pacific Power & Light Co.	Walla Walla	H	2,437

H—Hydro, IC—Internal Combustion, S—Steam

United States Capacity as of March 1—Hydro, 18,862,847 kw; Internal Combustion, 1,983,208 kw; Steam, 55,234,118 kw; Total, 76,080,173 kw.

POWER BRIEFS

- Building of Electric Energy Inc's plant at Joppa, Ill., has increased passenger traffic to the area to such an extent that Chicago & Eastern Railroad has extended the run of "The Meadowlark," operating between Chicago and the Ohio River, to include Joppa.

- A pilot who survived a power line crash is asking $31,500 damages from Pacific Gas & Electric Co and privately owned Bay Airport in Marin County, Calif. The pilot, Alfred L. LaCom of Glendale, Calif., crashed into two 60-kv transmission lines a year ago and his plane hit the ground in a marsh. He claims there were no lights at the field and that the power poles should have been painted orange and white.

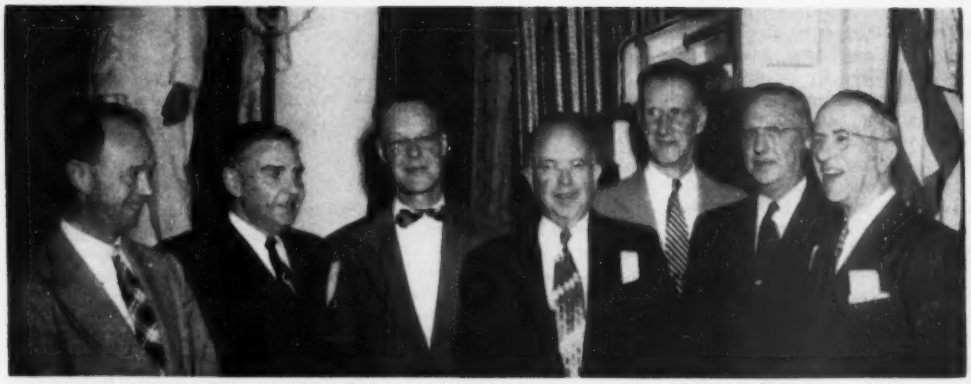
- Pacific Gas & Electric Co, San Francisco, has asked the Federal Power Commission for permission to build a $36-million hydroelectric project on the north fork of Feather River and on Butt Creek in Plumas County, Calif.

- The Advertising Council, New York, will conduct a campaign to urge qualified high school students to consider engineering as a career. Request for the campaign came from the Engineering Manpower Commission of the Engineers Joint Council.

- Seattle City Council has enacted a new electrical code that has been under study for the last two years. It replaces an old code in effect 20 years. The new code simplifies installation methods and allows use of new materials.

- The first 60,000-kw generator at Northern States Power Co's new Black Dog Lake plant south of the Twin Cities will go on the line in September. The plant will have an ultimate capacity of 300,000 kw.

- Sunnyvale City Council has passed an ordinance prohibiting construction of a Pacific Gas & Electric Co line through the town. The present line must be rerouted to clear approaches to Moffett Air Field which is being enlarged. Sunnyvale residents ask that the line be put underground, strung along mud flats of San Francisco Bay, or brought across the bay near Dumbarton Bridge.



EEI ENGINEERING COMMITTEE chairmen who attended conference were (left to right): G. V. Williamson, Union Electric Co of Missouri; J. A. Pulsford, Public Service Electric & Gas Co; H. M. Hill, Northern States Power Co; H. P. Seelye, Detroit Edison Co; H. H. Marsh, Duquesne Light Co; F. A. Redding, Southern California Edison Co; and J. H. Foote, Commonwealth Services

Substituting Aluminum for Copper . . .

. . . was the big problem discussed at the joint meeting of Edison Electric Institute engineering committees in Chicago

Problems involved in substituting aluminum for copper on overhead lines was the main discussion topic at the meeting of the engineering committees of Edison Electric Institute, May 5-7, at Chicago.

Other topics included control room instrumentation, the ASA C-50 standard for rotating electrical machinery, cold-weather operating problems of outdoor power plants, and the procurement of engineers.

"People today are looking for an opportunity in their field of employment, not just jobs," A. C. Monteith, vice president, Westinghouse Electric Corp, told a luncheon meeting. He listed six essential requirements for procurement and development of engineers:

1. Restriction of engineering job classifications to engineering.
2. Creation of a good training program.
3. Establishment of an educational program for young engineers.
4. Hiring and training of high school graduates to back up engineers.
5. Introduction of a management development program.
6. Follow-through on all programs.

Aluminum Sizes Standardized . . . Standardization upon nine copper-equivalent sizes of all-aluminum conductors above 4/0 has been approved 40 to 9 by the Transmission and Distribution Committee. The standard will go to ASTM for action, M. H. Pratt, Niagara Mohawk Power Corp, announced. Proposed sizes are 266,500; 366,400; 397,500; 477,000; 636,000; 795,000; 1,033,500; 1,272,000; and 1,590,000 circ mil.

Speaking for the minority David Burns, Detroit Edison Co, warned that some of the standard and ACSR sizes are identical. Confusion may result in using splicing sleeves.

W. R. Bullard, Ebasco Services, questioned the standard on four points:

1. Will fittings be interchangeable?
2. What will its effect be on manufacturers making both paper insulated cable (even circ mil sizes) and overhead conductor (copper equivalent sizes)?
3. Why not select all aluminum sizes that are equivalent to commonly used copper sizes?
4. While the recommended sizes are physically equivalent to certain copper sizes, are they economically equivalent in application?

Lively discussion followed a report by C. E. Baugh, Pacific Gas & Electric Co, on experiences with and life tests on aluminum-to-copper connections in areas subject to severe salt spray and industrial fumes. His records showed virtually serious universal deterioration in a year's time. This was especially true of connections exposed to salt spray. Conceding that climate and geography might explain the rapid deterioration on the PG&E system, he predicted that like trouble would develop elsewhere long before conductor has reached its life expectancy.

Others, Too, Have Trouble . . . Coastline company representative seconding Baugh's report included: R. E. Cargill, Gulf States Utilities, "We have thrown away bushels of every connector on the market." H. E. Jung, Southern California Edison Co, "Our troubles parallel those reported by Mr Baugh." J. P. Hayward, Atlantic City Electric Co, "We don't use aluminum in salt spray areas but restrict it to inland lines."

R. W. Kunkle, A. B. Chance Co, said ASTM salt spray tests produce results closely correlated with Baugh's findings. Irving Matthysse, Burndy Engineering Co, showed how precautions in making connections in aluminum-copper conductors would minimize deterioration.

Introduction of aluminum conductors into underground cables brings splicing and other problems beyond those met in overhead application. This was brought out in a symposium

EEI Engineers' Parley (continued)

opened by a paper by T. C. Duncan reporting Consolidated Edison practices and plans. By far the simplest method of connection is the compression type joint. Some 50,000 ft of 350 MCM aluminum cable is being installed on the low voltage system. Crab joints will be used extensively. Two 27-kv projects (56,000 ft) will have cables of 3-conductor, 4/0 compact strand.

Detroit Edison is moving toward aluminum for pipe-type cable, said L. W. Clark. E. C. Rue, Boston Edison Co, advised that more room be provided in manholes to allow for the greater thermal expansion of aluminum. R. J. Wiseman, Okonite Co, pointed out that the higher inherent resistivity of aluminum reduces both skin and proximity effect. This necessitates only 40 to 50% increase in cross-section for carrying capacity and not the 60% commonly cited.

Development of a standard a-c network vault smaller in size and lower in cost is an outgrowth of Wisconsin Electric Power Co studies of system expansion, Robert Powers said.

Kilovar Supply . . . In planning kilovar supply, C. H. Hoffman said Public Service Electric & Gas provides not only an amount equal to the load but also a reserve equal to the kilovar capacity of two large generators in the area. Unswitched capacitors up to the limit set by generator power factor at minimum loads are first choice for kilovar capacity.

As a result of representations made by utility engineers, the Air Conditioning and Refrigerationing Manufacturers Association has agreed to supply EEI with specific data on operating power factor and investigate the matter of power factor improvement, J. W. Anderson, Philadelphia Electric Co, reported.

Charges of the Outdoor Writers Association of America that chemical treatment of brush on rights-of-way destroys natural beauty of the landscape, poisons game, and destroys game cover were denied by F. A. Ashbaugh, West Penn Power Co. Treatment actually improves appearance by killing weeds that crowd out wild flowers, and other attractive growth. Ashbaugh said he knew of no instances where the death of an animal was traced directly to herbicides.

C-50 Amendment Tabled . . . Discussion in the Electrical Equipment Committee on the existing ASA C-50 short circuit clause resulted in tabling a proposed amendment which would have reduced the time, under the standards, for a generator to withstand line to line faults before it must be cleared. The proposed revision was referred back to the subcommittee for further study. The C-50 clause specifies requirements for synchronous generators during three-phase and line-to-ground fault conditions. The proposed revision specifies requirements for line-to-line faults.

Symposium on Control . . . Combined control boards for boiler-turbine-generator have been extensively accented. Now 40 plants (3,441 Mw) have them. These figures were given the EEI Prime Movers and electrical equipment committees by H. L. Lowe, Ebasco Services, in a symposium on control room instrumentation. None is over 10 ft long, he said. Operators reportedly like the sequential arrangement and mimic representation.

D. W. Taylor, Public Service Electric & Gas, concurred that the concentration of instruments requires functional arrangement. He makes a mock-up of each new control room and includes illumination in the analysis. That ash handling and similar functions should not be moved into the control panel is the belief of C. W. E. Clarke, United Engineers & Constructors.

Reduction in number of operators at recent Niagara-Mohawk plants was accomplished, said J. N. Ewart, by compact panels and studied locations of non-control instruments. Station economy controls should yield panel space to devices aimed at protecting the load and protecting the station equipment, asserted E. H. Krieg, Stone & Webster Engineering Corp.

Cold Weather Troubles . . . Some minor difficulties have been experienced in operating outdoor power plants during cold weather. As reported at the Prime Movers Committee round table, they pertained to brief periods of iced gratings, clogged draft fan inlet vanes, frozen soot blower mechanisms, and iced-up crane trolley wires. Considerable discussion was devoted to means of sealing pipe insulation. Indications were that manufacturers are considering methods of covering and joint sealing to keep out water.

Turbine governor-valve operability is checked by one company by using a differential gauge across the pilot valve to disclose any incipient tendency to stick.

To prevent erosion of the top tier of condenser tubes, most companies provide some means of physical deflection of the dropping water. None reported using resin coating on tubes.

Foaming of lubricating oil was largely attributed to the presence of a stearate traceable to some forms of rust prevention in the tanks or piping. Flushing out with the adopted lubricating oil was suggested as a corrective.

Dredge-type hose of large diameter was mentioned as satisfactory for passing coal, but others found it no better than iron pipe for flow or wear. Stainless steel lining has proved effective in pipes and bunkers handling wet coal.

Use of television for boiler monitoring appears to be expanding. Ten companies use it to watch water levels, 5 for flame, 2 for stack emission, and a few to check ignition.

Various measures were mentioned to stop fuel flow on loss of air from fans: centrifugal device (8), loss-of-voltage relays (15), tachometer (1), differential pressure switch (6), trip finger on circuit breaker (14).

Miniature Breaker Shown . . . Members of the Meter Committee were urged by J. C. Langdell to promote adoption of circuit breakers instead of fuses. He demonstrated one (Mechanical Products, Inc., Jackson, Mich.) that will be available in 15, 20 and 30 A ratings and will go in a standard fuse plug socket. Duncan Electric announced any extended range polyphase meter and a later combination with thermal demand meter. Code Electric has modified the meter enclosures for gang installation to permit straight through bus runs for either indoor or outdoor use.

Utility demand for indoor-outdoor type current transformers for low voltage metering runs 80% for 200A, 10% for 400A, and 10% for 600 and 800A, said E. H. Walton, United Illuminating, in presenting a tentative standard. Sentiment favored dropping the 600A rating if there were any advantage.

BROAD SMILES are evoked by J. F. Fairman, Depa administrator, as he addresses APPA. Amused listeners are E. R. Hoffman, Seattle City Light, left, and J. F. Ward, Tacoma City Light

Fairman Warns of Slippage

Depa administrator tells APPA convention about 3 million kw of capacity scheduled for this year won't be added

While power suppliers have reduced by over 800,000 kw their estimates of generating capacity to be added in the U. S. this year, the Defense Electric Power Administration feels the figure will actually be closer to 3 million kw—38 out of 217 generating units originally scheduled for 1952.

Depa Administrator James F. Fairman told the American Public Power Association annual convention in Seattle, April 29-May 1 that he could be more optimistic than this if the task in front of the manufacturers weren't so big—transformer manufacturers are scheduled to ship one third more capacity this year than in 1951, generator manufacturers 83% more, and boiler manufacturers 133% more.

Narrow Margin . . . He warned that we won't know where we stand for some months, since in-service dates on most of the equipment are in the third and fourth quarters—28% and 46%. Delays of a few weeks, he said, will make hundreds of thousands of kilowatts unavailable to meet December loads. Even if all the capacity now scheduled comes in, indicated gross margin between peak load now forecast and generating capability will be a little over 8%. He added that Depa expects slippage of new capacity will more than equal any failure of the load to materialize, so the expected margin will probably not be improved and may be worse than forecast.

Commenting on the Roanoke and Kings River controversies, Willard W. Gatchell, assistant general counsel of the Federal Power Commission, told the group that if the position of Interior Secretary Chapman is sustained "the policy of Congress to encourage development of water power resources by states, municipalities, and power utilities under the Federal Water Power Act will be substantially nullified. He added that if the licensing authority of the act is to be withdrawn, it should be done by Congress, not by administrative interpretation nor by the courts.

Lauds Cooperation . . . Washington's Gov Arthur Langlie added further fuel to the fires of basic conflict between federal and state and local interests in development of additional generation in the Northwest by stating flatly that he would continue to be opposed to federal construction of the Hells Canyon project while other projects with much better cost and benefit ratios for the people of the Northwest "are crying to be built." He lauded cooperation between public and private members of the Northwest Power Pool as proof that their problems could be solved on a local level.

Says Gas Is Losing Out in Commercial Cooking

"Gas is on the way out in commercial cooking." This was asserted by J. W. Palm, distributor of electrical food service equipment, at the Edison Electric Institute's Commercial Cooking Conference in Chicago, May 7.

Palm also declared that the combination gas and electric utility is absolutely worthless as a promoter of commercial electric cooking.

He urged that power companies put forth every effort to convince restaurant operators and equipment dealers that electricity is better than gas or any other fuel. He pointed out that it is easy to sell gas equipment because it costs less, harder to sell electric because the initial cost is greater. But in the comparison of values, as measured by the profit and loss account of the food service operator, electricity always comes out on top, he said.

The way to get electric cooking into institutional and other large food service installations, according to C. E. Sperow, Ohio Edison Co, is to work with the architect. And the way to do that is to get into the picture before the architect has made his plans, then give him detailed advice in the form of fully worked out designs and equipment specifications.

Indians Get Hydro Loan

The Metlakatla Indian Community on Annette Island near Ketchikan, Alaska, has received a $1,303,000 Rural Electrification Administration loan for construction of a hydroelectric project on Purple Lake in the mountainous center of the island. The project is expected to develop about 3,000 kw to supplement a 450-kw hydro plant on nearby Chester Lake and a 270-kw diesel electric plant.

CHAIRMEN and speakers at PEA's Industrial Sales Conference are (standing, l to r) Harry Restofski, West Penn Power; P. M. Alden, Philadelphia Electric, Business Development Section chairman; R. A. Gallagher, Pennsylvania Electric, PEA president; and (seated) Dr Eric A. Walker, Penn State College; and F. F. Dickman, West Penn Power, chairman of conference

Industrial Power Use Discussed

Pennsylvania Electric Association speaker urges sales engineers to increase applications of electrification

Power sales engineers should set their sights at a 10% increase in new applications of electrification for industry. This was the message of R. A. Gallagher, president of the Pennsylvania Electric Association and vice president of the Pennsylvania Electric Co, in addressing the Industrial Sales Conference sponsored by PEA's Industrial Committee May 1-2 at Wernersville, Pa.

He said that this must be accomplished by the end of 1953 if the civilian and military economies are to exist side by side. He urged the engineers to protect our "production for freedom" by challenging anything and anybody that endangers it.

How to Hold Salesmen . . . Harry Restofski, vice president of West Penn Power Co, appraised a good power salesman. He based his talk on the experiences of 12 power sales executives and summarized 26 important qualifications of a good power salesman. He said that if you want a good power salesman to continue as a power salesman you must (1) compensate him fairly, (2) give him opportunities for growth, and (3) give him one challenge after another to pique his interest and maintain his enthusiasm.

Dr Eric A. Walker, dean of the School of Engineering of Penn State College, told the group that this country's increasing use of the world's supply of vital materials will make it necessary to replace them with others. He said that there is a very real possibility for the use of atomic energy for the production of electricity.

Selenium Rectifiers . . . Selenium rectifiers offer many advantages over other types of rectifiers and are fast becoming a more important factor as a means of power conversion, said A. L. Barrett, Joy Manufacturing Co. He said that their cost is lower than other types, if voltage control is not a consideration.

The potential revenue of the metal sheath heater market for the utility industry from 240,880 manufacturing industries in the U. S. is equivalent to 50% of the present industrial sales, in the opinion of A. D. Spillman, Philadelphia Electric Co.

He said that with adequate promotional effort in the next ten years, this should approximate $750 million annual revenue.

Phone Service . . .

. . . to power companies in Pennsylvania explained to PEA meeting by Bell representative

A better understanding of operations of Bell Telephone Co of Pennsylvania is being obtained by several utilities and will make for improved service performance, D. K. Phillips, general sales manager, central area, of the Bell company, declared recently.

Phillips made this statement in a speech on "Unusual Bell Services and Equipment Available to Power Companies" before the spring meeting of Pennsylvania Electric Association's Communication Committee at Allentown, Pa.

Fruitful Discussions . . . The better understanding is a result of a series of group discussions with field employees of the utilities, stated Phillips, pursuant to subjects and comments presented at two previous PEA committee meetings (EW, Oct. 29, 1951, p 13; March 3, 1952, p 24).

Referring to new telephone equipment, Phillips told of a No. 500 combined set which has more easily read dials and a key in the base for regulation of bell tone. Another telephone unit is equipped with lucite buttons which have ringing and busy signals in the key itself. This instrument permits picking up two or more lines, holding a party on one line while conversing on the other line, intercommunication, and other features.

Engineers of power companies and the telephone company have collaborated, Phillips said, in developing a consolidated dispatching board for system dispatchers' offices. Facilities are provided for pickup, hold, cross connection, and ringing on associated lines. Teletypewriter machines, he stated, are being used for dispatching service calls, receiving clearance reports from distant points, and transmitting reports between offices.

Electric Industry Future Good

Optimistic forecast is made by speaker at National Federation of Financial Analysts Societies' convention

Good times for the foreseeable future were predicted for the electric industry at the fifth annual convention of the National Federation of Financial Analysts Societies meeting in San Francisco recently.

Recognizing the vast growth potential of the industry, Carl C. Brown, Laurence M. Marks & Co, New York, in an analyst survey declared that profits should increase, since the possibilities were that costs would level off—unless war should break out. Income taxes will also remain at present levels, he believed, pointing to the declarations of the various presidential candidates.

He emphasized, however, the need for a realistic climate to keep electric utility stocks attractive to investors.

Favoring Rate Payer . . . Many regulatory commissions, he indicated, are biased in favor of the rate payer, giving little heed to the interests of the stockholder. Also, they often allow such a time lag from the date of application to the date of granting the desired increase as to make the allowed increase then inadequate.

Western private power spokesmen told the analysts that while there had been some rough battles in the neighborhood since federal power had moved in, they believed the two were learning to live together. And that there was no doubt that western private power was here to stay, and grow, and make money for its stockholders.

As mentioned in "In the Industry" column in the issue of May 12 of Electrical World, James B. Black, president of Pacific Gas & Electric Co, told the forum that he certainly does not under-rate federal projects in California as a potential threat. But, he declared, "In our opinion there is no occasion under present Congressional policy to have misgivings as to our ability to live with them."

Federal Projects Overemphasized . . . Commenting that the relative magnitude of the federal power projects in California tended to be overemphasized, he pointed out that by the end of 1954, PG&E plans to have 4,150,000 kw of total capacity on its system. This will then approximate the combined installations, constructed and authorized, of all the great government projects on the Pacific Coast, Grand Coulee, Bonneville, Shasta, and Hoover Dams.

Speaking for the Pacific Northwest, Thomas W. Delzell, chairman of the board for Portland General Electric Co, vigorously challenged the term "public power empire" as applied to his area as a "completely false label."

Western Washington is the only strongly public power area, he declared. No new Public Utility District has been created in the Northwest in the last 12 years, he said. In Oregon in the last 15 years, he added, there have been 55 elections on the formation of PUDs. Of these 43 failed.

Private utilities serve 90% of all electric customers in Oregon, he said. PUDs serve only 2%, with REAs and municipal operations taking the remainder.

He explained to the analysts that the Northwest's peculiar geography, excesses of water in certain areas and seasons, and acute shortages of water in other areas, made federal reclamation help welcome and necessary, and that hydrogeneration at flood control and irrigation projects to help pay for benefits was sound practice.

He remarked in a wry aside, however, that reclamation had "strayed considerably" from that simple concept in the last 15 years.

Speaking on corporate pension trusts, J. D. Lockton, treasurer, General Electric Co, described the workings of his own company's trusts.

Pension Trust Buys Common . . . General Electric started in 1950 to put some of its pension trust money into common stocks, and plans eventually to keep from 20 to 30% of its money in this type of investment. About 34% of these stocks are chemicals and oils. Corporate bonds with an "A" rating or better make up the largest portion of the trust investment. Only about 19% of the portfolio is made up of government securities.

FINANCIAL BRIEFS

Major remaining controversy in the distribution of Washington Water Power Co stock to American Power & Light Co stockholders is over who shall choose the board of directors for the new WWP Co. Barring oral argument on this point, SEC may hand down a decision on the American plan of distribution shortly.

Morton E. Yohalem has tendered his resignation as Director of the Division of Public Utilities of the Securities and Exchange Commission.

Iowa Electric Light & Power Co has sold $5 million first mortgage 3⅛% bonds due 1982 to 12 institutions . . . **Columbus & Southern Ohio Electric Co** plans to sell 200,000 common shares as first offering in 1953, if the market is right.

Puyallup, Wash., City Council has set June 14 for special election to decide whether the city should issue up to $2.5 million in bonds to buy Puget Sound Power & Light Co and set up a local Public Utility District.

Delaware Power & Light Co has just released its "Historical, Operating and Financial Statistics" for 1951. For copy write: J. W. Mackie, Comptroller, Delaware Power & Light Co, 600 Market St., Wilmington 99, Del.

REGULATION

Pennsylvania Public Utility Commission suspends proposed Pennsylvania Power & Light Co $2.7 million rate increase another three months to Aug. 12 . . . **Madison, N. J.** makes a half-cent reduction in residence rates on all consumption over 100 kwhr monthly. Reduced rate, from 4 to 3½¢, becomes effective July 1. A similar half-cent reduction was made 15 months ago.

Today in Utility Finance

YIELDS (%)

Quality	Bonds			Preferred Stocks			Common Stocks		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE									
1952									
May 8	2.94	2.98	3.10	4.03	4.24	4.57	5.36	5.99	6.35
May 1	2.94	2.97	3.10	4.03	4.25	4.60	5.42	6.08	6.61
1st 1952	2.95	2.99	3.13	4.11	4.29	4.66	5.35	6.03	6.47
4th 1951	3.02	3.07	3.21	4.32	4.50	4.91	5.42	6.18	6.84
3rd 1951	2.87	2.91	3.04	4.05	4.27	4.61	5.52	6.24	7.05
2nd 1951	3.01	3.11	3.23	4.11	4.37	4.68	5.73	6.38	7.37

Data: Reis & Chandler, Inc.

EARNINGS

Company	Period Months	Ended	Net Income 1952	Net Income 1951	Earnings Per Common Share 1952	Earnings Per Common Share 1951
Arizona Public Service	12	Mar.	$2,336,182	$2,110,244	$ ...	$ ...
California Electric Power	12	Mar.	1,810,552	1,672,487	.65(a)	.61(a)
California Pacific Utilities	12	Mar.	497,238	496,757	1.85(b)	2.01(b)
Central Illinois Public Service	12	Mar.	4,978,230	5,290,050	...	...
Commonwealth Edison	12	Mar.	28,664,949	29,935,478	...	...
Idaho Power	12	Mar.	3,500,240	2,954,709	3.12	2.56
Kentucky Utilities	12	Mar.	3,931,566	4,037,136	...	...
Lake Superior District Power	12	Mar.	864,408	797,134	...	...
Michigan Gas & Electric	12	Mar.	425,750	394,851	2.67	2.44
Northwestern Public Service	12	Mar.	875,409	876,724	...	...
Pacific Power & Light	12	Mar.	3,840,876	3,233,391	...	...
Pennsylvania Water & Power	3	Mar.	361,036(c)	290,279	64	61
Shawinigan Water & Power	3	Mar.	1,332,033	1,122,121	494	397

NOTES—(a) On shares outstanding at end of each period; (b) On average number of shares outstanding during the period, and (c) Estimated.

FINANCING

Company and Description	Amount of Offering ($000)	Offering Price	Yield to Public
WEEK OF MAY 8-14			
Bonds			
Worcester County Electric—1st mtg 3¼% 1982	$4,000	102.125%	3.14%
Common Stock			
New York State Electric & Gas—300,000 sh	$9,525	$31.75	5.35%
WEEK OF MAY 15-21			
Bonds			
Central Vermont Public Service—1st mtg 1982	$1,500		
Iowa Power & Light—1st mtg 1982	10,000		
SCHEDULED FOR MAY-JUNE			**Bid Date**
Bonds			
Kansas Gas & Electric—1st mtg 1982	$12,000		June 10
Northern States Power (Minn.)—1st mtg 1982	21,500		June 10
American Gas & Electric—debentures 1977	20,000		June 17
Boston Edison—1st mtg 1982	16,000		June 17
Kentucky Utilities—1st mtg 1982	12,000		June 17
Public Service Electric & Gas—debentures 1972	40,000		June 17
Gulf Power—1st mtg 1982	7,000		June 24
Preferred Stock			
Dallas Power & Light—100,000 sh no par	$		May 26
Long Island Lighting—100,000 sh $100 par	10,000		(b)May 27
Tampa Electric—50,000 sh $100 par	5,000		June 3
Public Service Co of Indiana—800,000 sh $25 par			(c)June 17
Common Stock			
Central Vermont Public Service—108,900 sh (to be offered to commonholders on 1-for-6 basis; record May 20 to expire June 3; New England Public Service, owner of 35.5% of common to waive its subscription rights; price will be determined by competitive bidding)	$		May 19
New England Electric System—920,573 sh (being offered to commonholders on 1-for-8 basis; record May 8 to expire May 26)	$11,622	$12.625	7.13%
Iowa Power & Light—226,928 sh (being offered to commonholders on 1-for-7 basis, record May 14 to expire May 28)	4,822	21.25	6.59
Wisconsin Electric Power—702,486 sh (being offered to commonholders on 1-for-5 basis (a), record May 6 to expire May 29)	14,050	20.00	6.50
Virginia Electric & Power—494,642 sh (to be offered to commonholders on 1-for-10 basis (a), record May 23 to expire June 9)			...
Kansas Gas & Electric—200,000 sh			June 10
Northern States Power (Minn.)—1,108,966 sh (to be offered to commonholders on 1-for-10 basis, record June 5 to expire June 23)			June 4
Southern Co—1,004,510 sh (to be offered to commonholders on 1-for-16 basis, record June 19 to expire July 10; company will set stock price; underwriters will be selected by competitive bidding)			June 18
Tampa Electric—60,000 sh			June 3
American Gas & Electric—170,000 sh			June 17

Notes—(a) Stockholders allowed oversubscription privileges; (b) W. C. Langley & Co group underwriters, and (c) May be a negotiated deal.

CALENDAR

Northwest Electric Light & Power Association
Personnel Section, Vancouver Hotel, Vancouver, B. C., May 19-21; Accounting-Business Practice Section, Medford Hotel, Medford, Ore., May 22-23.

Illuminating Engineering Society
East Central Regional Conference, Webster Hall Hotel, Pittsburgh, Pa., May 21-23; Northeastern Regional Conference, Hotel Preston, Swampscott, Mass., June 19-20.

Edison Electric Institute
Accident Prevention Committee, Indianapolis Athletic Club, Indianapolis, Ind., May 22-23; 20th Annual Convention, Cleveland Public Auditorium, Cleveland, Ohio, June 2-4; Accident Prevention Committee, Sheraton Hotel, Rochester, N. Y., Sept. 15-16.

Pennsylvania Electric Association
Spring Meeting, Systems Operation Committee, Allenberry Lodge, Boiling Springs, Pa., May 22-23; Spring Meeting, Transmission-Distribution Committee, Irem Temple Country Club, Dallas, Pa., May 22-23; Spring Meeting, Prime Movers Committee, Tidewater Inn, Easton, Md., May 28-29.

***Missouri Association of Public Utilities**
1952 Convention, Hotel Missouri, Jefferson City, Mo., May 27-28.

C.I.G.R.E.
(International Conference on Large Electric High-Tension Systems), 14th Biennial Session, Paris, France, May 28-June 7.

National Association of Electrical Distributors
44th Annual Convention, Hotels Ambassador-Chelsea, Atlantic City, N. J., June 9-12.

International Organization for Standardization
Triennial Meeting, Columbia University, New York, June 9-21.

Pacific Coast Electrical Association
Annual Convention, Hotel del Coronado, Coronado, Calif., June 11-13.

American Society of Mechanical Engineers
Semi-Annual Meeting, Sheraton-Gibson Hotel, Cincinnati, Ohio, June 15-18.

***National Association of Corrosion Engineers**
Short Course on Corrosion sponsored jointly by Cleveland Section of NACE and Case Institute of Technology at the institute, Cleveland, Ohio, June 16-20.

American Institute of Electrical Engineers
Summer General Meeting, Hotel Nicollet, Minneapolis, Minn., June 23-27.

American Society for Testing Materials
Annual Meeting, 50th Anniversary, Hotels Statler-New Yorker, New York, June 23-27.

National Retail Credit Association
International Consumer Credit Conference, Statler Hotel, Washington, D. C., June 23-26.

Canadian Electrical Association
Annual Convention, Banff Springs Hotel, Banff, Alberta, June 30-July 2.

***Maryland Utilities Association**
Cavalier Hotel, Virginia Beach, Va., Sept. 5-6.

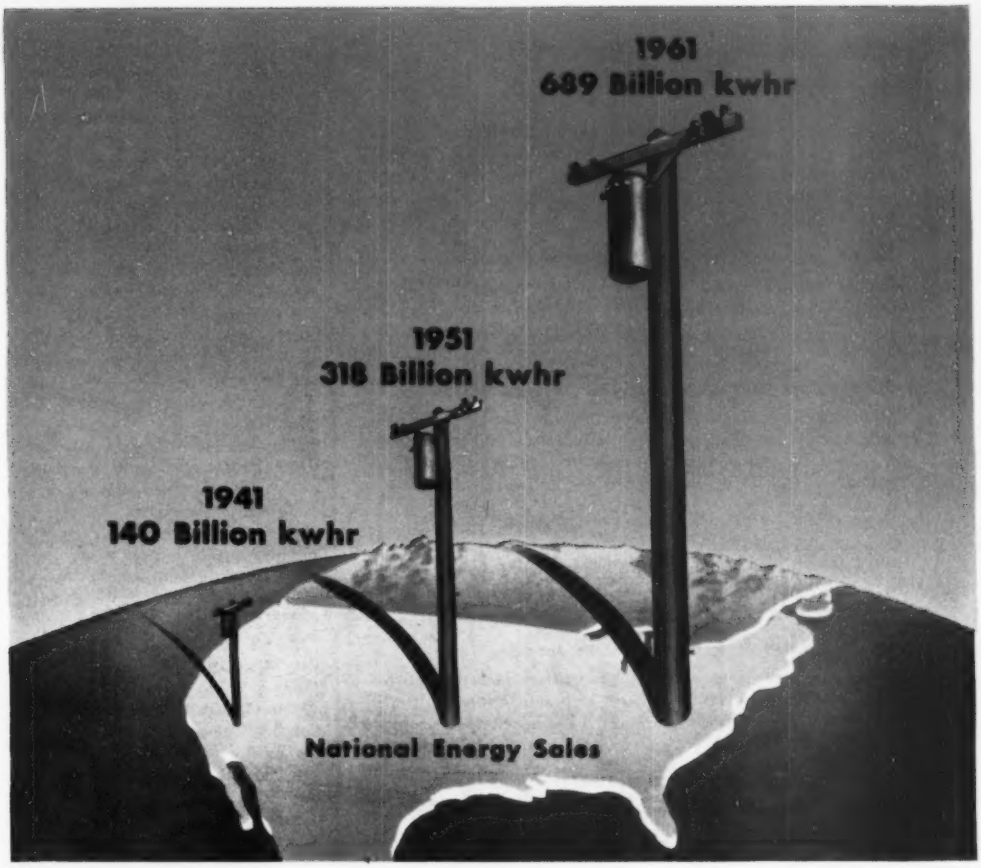
***Rocky Mountain Electrical League**
Fall Convention, Colorado Hotel, Glenwood Springs, Colo., Sept. 7-10.

***National Electronics Conference**
8th Annual Conference, Sherman Hotel, Chicago, Ill., Sept. 29-30 and Oct. 1.

***American Standards Association**
National Standardization Conference, in conjunction with Centennial of Engineering, Museum of Science-Industry, Chicago, Ill., Sept. 8-10.

***Public Information Program**
Annual Workshop Conference, Edgewater Beach Hotel, Chicago, Ill., Sept. 18-19.

*Addition this week.



Distribution for Tomorrow

With nearly half of the industry's money invested in expanding distribution systems, now is the time to look into the future

Electric power systems of this country are adding distribution facilities at a rate of more than a billion dollars a year. Ten years ago additions were only one quarter of this amount. Annual growth of electric systems then was half the percentage rate of today.

Distribution facilities represent nearly half the existing investment in utility power systems; and when combined with subtransmission, they will continue to absorb half the dollars.

By far the largest system operating and maintenance expenses are related to the distribution system. Correspondingly, a large part of our electrical manufacturing research, development, and production facilities are devoted to equipment for the distribution system.

For these reasons, Electrical World is devoting this issue to a thorough review of the projected growth of the distribution system load and to the planning of facilities to provide an adequate power supply.

A Time of Decision . . . Today, as we reach the peak of the mobilization effort and pass on to more normal periods, managements of electrical utilities are faced with critical decisions. Will they complete the programs laid out on the basis of full use of industrial facilities as now planned . . . or will they cut back to more conservative levels? Will they maintain an optimistic view of markets yet untapped, or will they leave building to someone else? Will they seek new heights in economical system design or follow past precedents?

In the pages that follow Electrical World presents its latest predictions

Ten Considerations in Planning Distribution for Tomorrow

1. **Subtransmission is an adjunct of distribution**

   Subtransmission takes the burden of expansion off distribution. It links sources and affords multiple and back up supply by incorporating regulation and phase control, distribution's job.

2. **Higher voltage offers escape from inadequacy**

   Higher voltage primaries have inherent economic merit. But careful analysis may justify retaining 4 kv. Logical evolution is more load per circut and per substation alongside higher voltage.

3. **Performance is a neglected guide to good design**

   Performance of distribution systems has not received the same critical analysis as that of transmission and generation systems. It's time to take stock and point distribution design toward better results for fewer dollars.

4. **Good voltage regulation is a fundamental**

   Voltage regulation is adequately achieved by judicious use of fixed and switched capacitors along with manipulation of bus voltage. Adjustment at load and source handles load variation with minimum uses of feeder devices.

5. **Substation development is vital to economy**

   Factory-assembly makes substations easy to install or move when load changes require. These unit substations embrace basic functions of transformation, regulation, and protection; are easy to duplex for expansion; and high salvage.

6. **Secondary conductors need not be replaced**

   Secondary distribution is not the place about which to worry. Until three-phase service comes, No 2 copper is proving ample even for house heating. It's a matter of bigger transformers, closer together.

7. **Reclosers can contribute to reliability**

   Reclosers, systematically applied, reduce disturbances and outages. Service crews can take care of larger territories. Most interruptions are momentary and warrant automatic reclosure, today.

8. **New techniques can handle high rural line loading**

   To meet mounting rural line loads these expediants are at hand: Higher circuit voltage, addition of third-phase wire, and more frequent spacing of substations.

9. **Switched capacitors can enhance adequacy**

   Switched capacitors pare investment for a whole system. They reduce circuit loading, hold up voltage without causing high voltage at light load. Applied anywhere, moved or expanded readily, they are a logical tool of expansion.

10. **Sound pole-top design averts costly accidents**

    Pole top congestion is poor economy. While ample pole top design may cost more, cost of accidents can wash out false economy of inadequate climbing space, work area, and clearance.

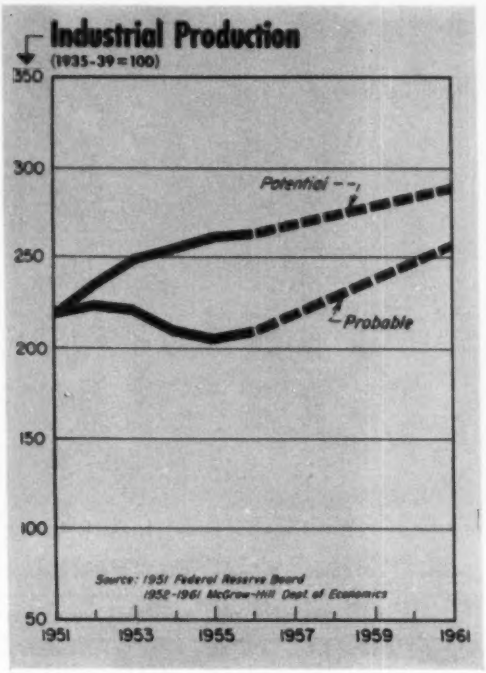
of the economic climate under which our electric systems will grow and prosper. We also submit our annual forecast of the ten year growth of the electrical industry in terms of peak load, energy use, and capacity needs.

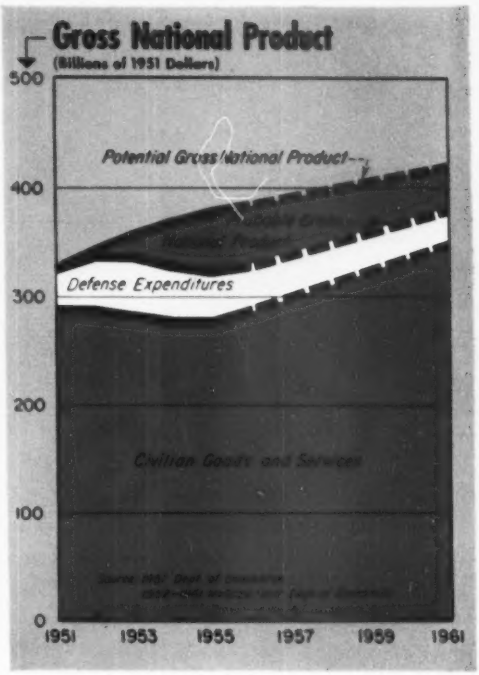
Growth Creates Problems . . . Distribution systems for tomorrow command attention today as growing loads direct the scrutiny of designers toward components of system that are now inadequate to handle the heavy load densities that lie only a decade away. By 1961 peak loads may reach 150 million kw for the nation as a whole. Corresponding to this demand is an output figure of 800 billion kwhr. This compares dramatically with 1951 peak load and output figures of 70 million kw and 372 billion kwhr.

Significance of these figures, insofar as they concern distribution system requirements, has often been overshadowed in recent years by preoccupation with generation and transmission needs that involve definite, compact, and definable units of system. By comparison the job of planning adequate distribution system development involves detailed and ramified studies reaching into remote system corners. It is a rare distribution development indeed that can rival the stature or sheer glamour of a new generating station or transmission line. For taken one at a time distribution projects are relatively small in size. Yet year in and year out they aggregate in dollars invested as much or more than any other major capital expenditure. Hidden in this mass of seemingly minor projects are opportunities for saving that can bulk large in any company.

Widening Boundaries . . . Distribution for tomorrow involves more than poles, wires, and crossarms. It already reaches up into subtransmission as well as out and down into the customer's premises. Tomorrow it promises to encroach even further into voltages initially associated with bulk transmission and transfer of electric energy.

In contributing to this broadened approach to the distribution problems of tomorrow, the editors of Electrical World have assembled the following symposium weighing essentialities affecting various components of system. Some of the highlighted inferences to be drawn from this symposium are summarized elsewhere on this page.





FRB Industrial Production Index (1935-39 = 100)

	1951	1952	1953	1954	1955	1956	1961
Probable	220	225	222	210	205	210	260
Potential		235	250	257	262	265	290

Gross National Product (Billions of 1951 Dollars)

	1951	1952	1953	1954	1955	1956	1961
Probable	328	340	340	330	325	330	380
Potential		345	360	370	380	385	420

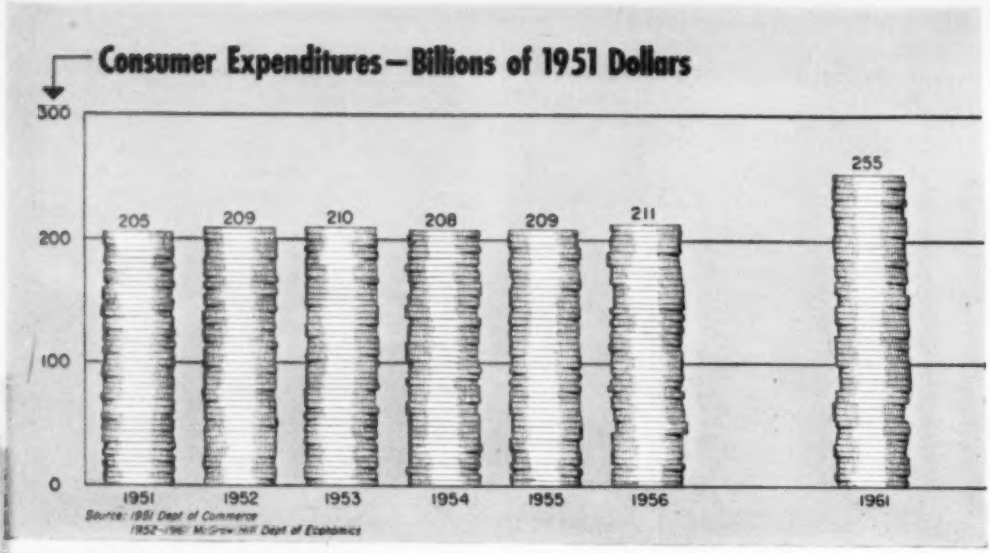
The Economic Outlook

Range of possible economic activity in the near future is very wide. Cuts in defense spending could cause a recession. Renewal of full-scale arms production could push industrial production to limit

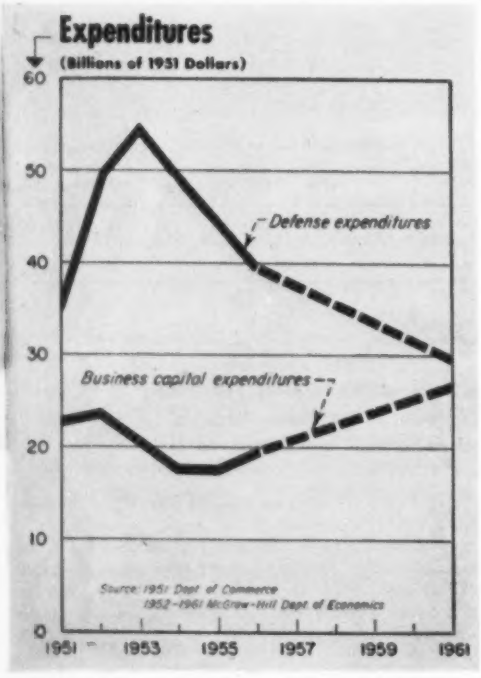
The economic outlook for 1952, and even more so for the years to follow, is complicated by the fact that we are entering a lull in the cold war. If there are no new international incidents, if the Russians continue to extend peace feelers, it seems very likely that our own armament program will level off before the year is over and that arms expenditures in the years 1953-56 will be considerably less than recently forecast. In this case, there will be very little strain on our economy during the next few years. In fact, considerable slack may develop. A significant part of the productive capacity now being installed by industry may remain unused.

It is always possible that the cold war will grow hot again and that a renewal of full-scale arms production or a new wave of scare-buying by consumers will again push industrial production to the limit. The business man is caught between the risk of having some idle capacity and the risk of not having enough capacity if the economy takes another sharp upturn. It should be noted that in many cases, such as aluminum or machine tools, the capacity is being built anyway, with government guarantees to take care of any excess which may develop. For this reason, the possible range of economic activity in the near future is very wide.

Industry and Defense Interlocked . . . However, so much of industrial activity now is tied to the defense program that it seems wise to anticipate some sort of business recession once it becomes clear that defense expenditures are heading down. Business plans for new plant and equipment already show a downtrend for the years after 1952. And backlogs for some consumer durables are apparently exhausted. The most likely prospect, therefore, is a less active economy after 1952.



CONSUMER EXPENDITURES may be expected to level off. Indications are that as a result demand for a large number of hard goods will weaken



INDUSTRY WILL SPEND LESS ON PLANT AND EQUIPMENT as defense and consumer expenditures level off. But long-range plans call for continued large expenditures on plant modernization

Consumer and Business Spending (Billions of 1951 Dollars)

	1951	1952	1953	1954	1955	1956	1961
Consumer expenditures	205	209	210	208	209	211	255
Business capital expenditures	23	24	21	18	18	20	27

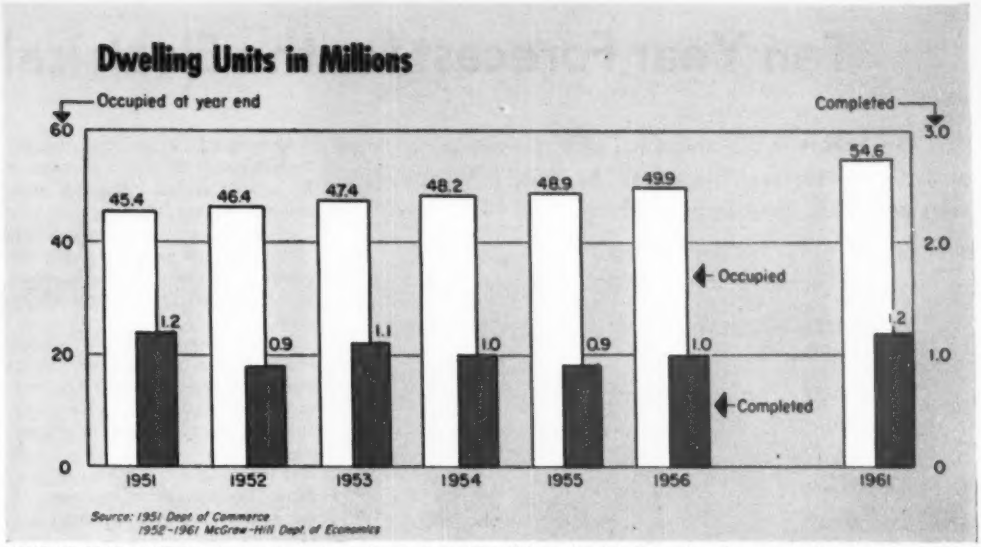
The figures indicate what the range of economic activity might be if we do have a moderate recession. There is also shown the potential range of economic activity at our greatly increased capacity if defense requirements again rise sharply. The latter figures represent capacity under conditions like those of 1951 and do not reflect the wartime possibilities of extra shifts and extra labor recruiting.

In these tables, it is assumed that a recession would not get really underway until late in 1953; so the 1953 average for economic indicators might be close to 1952, but the full drop shows up in 1953-1955.

Drop in Business Not Severe . . . Actually the drop shown is not severe by comparison with past business cycles. It's hard to see how there could be a real smash with defense spending probably continuing around $40 to $50 billion per year, compared with a peak rate in 1952 or early 1953 of $55 billion.

Also there are large backlogs of demand for many types of non-defense construction (commercial buildings, public works, schools, etc). And there may well be demand for close to one million new housing units per year in the mid-'50s, even though more of these units than recently will have to be replacement housing, preceded by slum clearance. Vigorous government action may be expected in all these fields of construction. And for this reason, the total volume of construction activity is not likely to fall much below recent levels.

However, there will very definitely be a shift in the composition of construction activity. More of it will be public works. Less will be housing. And not all the new homes constructed will mean new customers for electric utilities or electric appliance dealers. As more new houses



HOUSING CONSTRUCTION will slow down with decline in the backlog of demand and in the number of persons in the marriage-age group

Dwelling Units Completed and Occupied (Millions)

	1951	1952	1953	1954	1955	1956	1961
Completed.....	1.2	0.9	1.1	1.0	0.9	1.0	1.2
Occupied at end of year.....	45.4	46.4	47.4	48.2	48.9	49.9	54.6

are completed, an increasing proportion of existing houses will be demolished or left vacant. As shown in the table the number of occupied dwelling units will not rise as rapidly as the number of units completed. This slowdown in household formation will be one of the big factors in the economics of the mid-'50's.

The reason for lower completions in 1952 is mobilization restrictions which held down housing starts in the late months of 1951. More starts this year and early next year will mean more completions in 1953. But from 1954 to 1956, completions will decline, and the increase in occupied units will slow down even more. There won't be much backlog demand left, and the number of persons in the marriage-age group will be very low during these years. Easy credit and slum clearance projects can help people move to better homes. But they can't increase the number of people to live in homes—even if they're built.

Slow-Up in Housing Demand a Warning . . . The coming slow-up in housing demand is another reason for viewing the mid-'50's with caution. As demand for many consumer durables depends on the number of new households, it's hard to see business booming in consumer lines. And with both defense expenditures and consumer expenditures leveling off, business firms are likely to spend less on plant and equipment.

All this adds up to the likelihood of a significant recession in business from the levels now prevailing. But nothing like the depression of the '30's is in prospect. Even at the lower levels indicated for 1954 and 1955 gross national product and industrial production would remain well above the pre-Korea levels. And at least 75% of our total plant capacity would be fully utilized. There have not been many years, except when we were at war or when we were threatened by war, when the ratio was over 90%.

A recession of these modest proportions will not throttle the growth potential of our economy for the long run. There will still be enough new construction, enough new equipment installed in factories, enough research into new products to provide a steady increase in our industrial capacity—although obviously there will not be the incentive to expand at the recent break-neck pace. The long-range plans of most industrial companies, as shown by a McGraw-Hill survey earlier this year, call for a cut in spending for new capacity but continued large expenditures on plant modernization, even during a recession.

Long-Term Economy Growth Potential Great . . . This means that whenever the economy completes its downward readjustment from the peak of the post-Korea defense boom, the long-term growth potential will be very great. By 1961, industrial production may be 20% higher than in 1951, even if there is no forced draft under the economy. And under conditions such as we have had since Korea, the increase might be more than 30%.

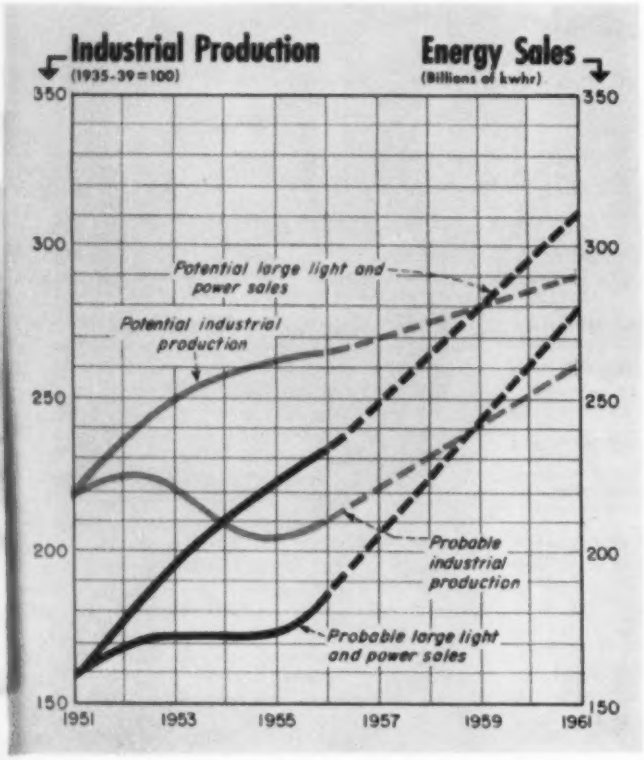
Some of this productive potential will be available long before 1961, if the need arises. If another Korea should break out in 1954, for example, it should be possible, without extra-shift operations, to push the Federal Reserve production index close to 260—compared to the probable 1952 level of 225.

Both factors—short-term readjustment and long-term growth potential—are important in the economic outlook. Everyone should recognize the short-term problem. But it is equally important to remember that—as it showed in 1942 and again in 1950—the American economy has a tremendous latent growth potential.

Ten Year Forecast for the Electrical

A 49% growth in sales requiring 60% increase in capability predicted for the next five years. By 1961, 117% growth in sales and 128% increase in capability

DISTRIBUTION FOR TOMORROW



USE OF ELECTRICITY per unit of the FRB industrial production index will continue to increase as industry mechanizes and uses more electrical equipment and installs more lighting. This is responsible for the forecasted steadiness in "probable" sale of electricity to industrial customers at a time when the index of industrial production is declining

Growth of the electrical industry exceeds that of the American economy by a wide margin. Although gross national product may increase only 16% in the next ten years, it is predicted that the sales of electrical energy will more than double. Even in the next five years growth will be great.

Use of electricity by the average residential and rural customer can be expected to increase from 2,140 kwhr in 1951 to 3,110 kwhr in 1956. Since 1937 the annual increase in use per customer has averaged 6.7%. Last year the increase was 9.8%. In preparing this forecast it was assumed the rate of increase in annual use would gradually decline to 7%.

An increase of 7.1 million residential and rural customers by 1956 (based on the preceding economic forecast) when combined with average annual use gives total sales to this class of customers of 146 billion kwhr in 1956, 71% over 1951.

The 1937 to 1951 average increase in the annual use of electricity by the average small light and power customer was 6.1%. Last year the increase was 11.6%. We have assumed that future increases will be somewhat above 7%.

Estimated increase in small light and power customers is from 5.5 million in 1951 to 6.1 million in 1956. Combining this latter figure with an estimated average use of 15,400 kwhr in 1956 gives total sales of 94 billion kwhr, 64% above 1951.

The use of electricity per unit of industrial production will continue to increase as more and more electrical facilities are installed in the nation's factories. This is responsible for the

Electrical World's Annual Forecast of the

	Population (Millions)	Dwelling Units* (Millions)	RESIDENTIAL & RURAL Customers* (Millions)	Average Use (Kwh) Customer	Sales (Billion Kwh)	SMALL LIGHT & POWER Customers* (Millions)	Average Use (Kwh) Customer	Sales (Billion Kwh)	MISCELLANEOUS Sales (Billion Kwh)	ATOMIC ENERGY Program Requirements (Billion Kwh)	LARGE LIGHT & POWER Probable Industrial Production**	Probable Sales (Billion Kwh)	Potential Industrial Production**	Potential Sales (Billion Kwh)
1951..	154.2	44.7	40.0	2140	85.5	5.5	10,400	57.3	17.5	—	220	157.8	—	—
1952..	156.8	45.9	41.7	2330	97	5.6	11,400	64	18.5	—	225	169	235	176
1953..	159.0	46.9	43.2	2520	109	5.8	12,400	72	19.5	—	222	173	250	195
1954..	160.8	47.8	44.6	2710	121	5.9	13,300	79	20.5	12	210	173	257	210
1955..	162.6	48.6	45.8	2920	134	6.0	14,400	87	21.5	24	205	174	262	222
1956..	164.6	49.4	47.1	3110	146	6.1	15,400	94	22.5	24	210	186	265	234
1961..	175	54.1	53.3	4120	220	7.0	19,700	138	27.0	24	260	280	290	312

Industry

forecast steadiness in the "probable" sale of electricity to large light and power customers.

Sales of energy to large light and power customers will probably reach 186 billion kwhr in 1956. Should industrial production reach the "potential" level discussed in the preceding economic forecast, sales to this class would reach 234 billion kwhr.

To either of these we have added another 12 billion kwhr in 1954 and 24 billion each year thereafter to account for energy usage by the proposed atomic energy program.

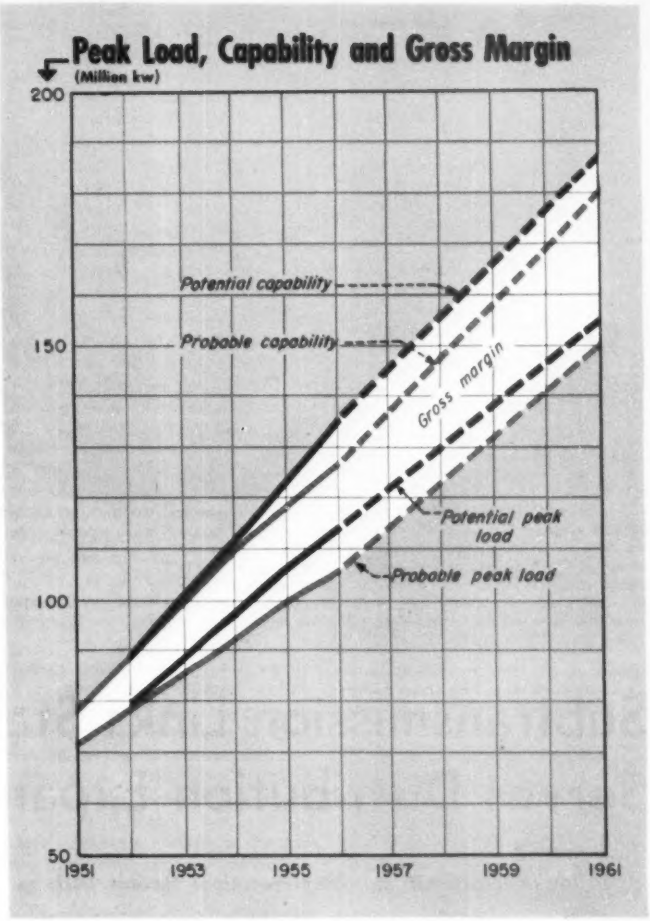
Total sales of electric energy will "probably" reach 473 billion kwhr in 1956. If, however, defense requirements rise sharply, total sales may reach the "potential" level of 521 billion kwhr.

Most forecasts agree that load factors are tending to increase as we have assumed in arriving at peak load estimates.

The capability of Class I systems under median hydro conditions was 75 million kw at the end of 1951. On this basis the capability of all systems was an estimated 79 million kw. This shows a 12.2% reserve over the 70.4 million kw non-coincident peak.

If the industry secures the 31 million kw of additional capacity forecast through 1954 it will have a 19.6% gross margin over the "probable" 92 million kw peak. A "potential" 97 million kw peak would leave a 14.5% gross margin.

The industry's own plans indicate that it requires an average of 20% gross margin under median hydro conditions at time of winter peak. Individual systems normally plan for about 15% margin at the time of peak, winter or summer. Therefore capability based on a "probable" peak of 105 million kw in 1956 will reach 126 million kw. A "potential" peak of 113 million kw would require a capability of 136 million kw to maintain a 20% gross margin.



PEAK LOAD OF 105 MILLION KW will "probably" be experienced in 1956, despite a moderate business recession. A 20% gross margin under median hydro conditions will require a 126 million kw capability. Defense activity could push peak to 113 million kw

Ten Year Growth of the Electrical Industry

TOTAL SALES Probable (Billion Kwh)	TOTAL SALES Potential (Billion Kwh)	Losses & Co. Use (% Output)	OUTPUT Probable (Billion Kwh)	OUTPUT Potential (Billion Kwh)	LOAD FACTOR Probable (%)	LOAD FACTOR Potential (%)	PEAK LOAD Probable (Million kw)	PEAK LOAD Potential (Million kw)	CAPABILITY Probable (Million kw)	CAPABILITY Potential (Million kw)	GROSS MARGIN Probable (% Peak)	GROSS MARGIN Potential (% Peak)	
318.2	—	14.5	371.9	—	60.3	—	70.4	—	79.0	—	12.2	—	..1951
349	356	14.5	408	417	59.8	60.0	78.0	79.5	88.8	88.8	13.9	11.7	..1952
374	396	14.5	436	462	59.0	60.0	84.5	88.0	101	101	19.5	14.8	..1953
406	443	14.5	475	517	59.0	61.0	92.0	97.0	110	111	19.6	14.5	..1954
441	489	14.5	517	572	59.2	61.5	100.0	106.0	119	123	19.0	16.0	..1955
473	521	14.5	553	610	60.0	61.6	105.0	113.0	126	134	20.0	18.5	..1956
689	721	14.0	800	840	61.0	62.0	150.0	135.0	180	186	20.0	20.0	..1961

* Average For The Year
** Federal Reserve Board Index of Industrial Production (1935-39=100)

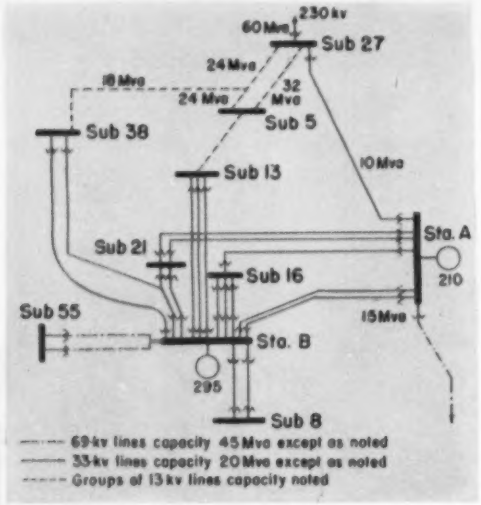


FIG 1—MAIN TRANSMISSION and subtransmission system prior to addition of generating station C. General plan for the 33-kv ties was developed in 1933 with the installation of the first 35-Mw unit at station B. As the load at a substation grew the original 13.8-kv supply cables were cut to serve distribution load from both ends and 33 kv cables added to supply the total station load. New stations since 1940 have been fed at 69 kv; all substation buses at 13.8 kv

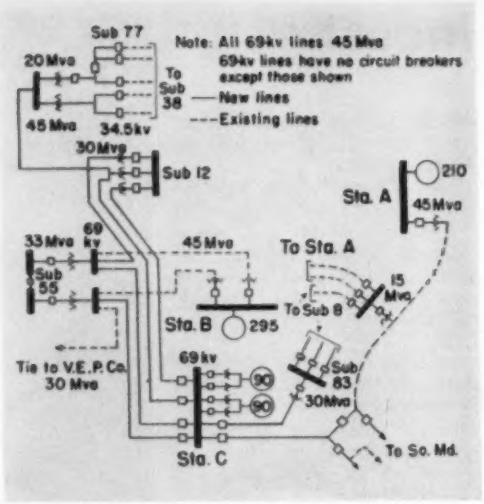


FIG 2—SUBTRANSMISSION LINKS added when units at station C were installed show links of distribution and energy transfer

D. C. VAUGHAN, System Planning Engineer, Potomac Electric Power Co, Washington, D. C.

Subtransmission Links Stations and Serves Distribution Expansion

Intermediate-voltage system functions flexibly both as means of providing two or more sources for distribution supply and as means for achieving economy in generation

Some of the considerations in designing subtransmission to supply substations having up to 100 Mva in firm capacity will be discussed. Load supplied would be low voltage ac networks, commercial or industrial customers up to 20 Mva, or smaller 13 to 4-kv distribution substations.

Studies have shown that such substations can supply load densities of up to about 200 Mva per sq mile. Beyond this density it is very probable that the high cost and difficulty of obtaining suitable sites may justify larger stations. This would reduce the cost of spare capacity to firm up the supply but increase the cost of distribution to the load. A possible variation of this would be the use of the same site for two substations normally electrically independent on the low voltage side.

Dual Purpose System . . . By providing two different power sources, the subtransmission can serve both to supply the distribution load and as a major source of power transfer between sources to obtain improved generating economy. Fig 1 gives an example of this on the system supplying Washington, D. C. and contiguous areas in Maryland and Virginia. Except for the two direct ties between generating stations all lines serve two purposes. One is to furnish each substation with sufficient capacity to permit loss of the largest supply line. The second is to permit the maximum output of either generating station at peak time and as close to equal incremental cost loading during off-peak periods as could be justified by the investment required.

Type of Cable . . . One important decision in planning the subtransmission system is whether to use single-conductor or three-conductor cable. At the present time, three-conductor, oil-filled cables are limited to about 69 kv, 650 Mcm by the size of the sheath. These will have a normal summer capacity of about 50 Mva. A conservative value for medium-pressure gas-filled cable is 600 Mcm, which has a summer capacity of about 45 Mva with a 77% load factor and four cables per duct line. Where grades or distances are such that stop joints would be required in the oil-filled cable, the oil-filled cable has the disadvantage of higher operating costs

and requires an alarm system to indicate abnormal pressures in reservoirs mounted in manholes.

Table I gives some figures illustrating the advantages of using the highest possible cable voltage. Under normal conditions a 115-kv gas or oil pipe cable having a capacity of 100 Mva or more will give a still lower cost per kva of installed capacity, but this may easily be offset by the increased amount of spare capacity required to protect for the outage of one cable. It will also require either a larger size substation with greatly increased cost of switchgear or a more complicated system with more substations connected to each subtransmission feeder.

Upped Feeder Capacity . . . Later additions in connection with the installation of generating station C in 1949 illustrate the use of 45-Mva transmission lines. Studies were made of several plans for distribution from it to the load centers. One possibility was construction of a 230-kv loop around the system. To obtain the right-of-way line, it would have been necessary to go so far from the major loads that the cost of subtransmission back to these loads approached the cost of lines direct from the generating station. Studies of various possible cable voltages led to the selection of three-conductor, 600-Mcm, 69-kv, medium-pressure gas-filled cable.

This size would ultimately require 12 cables for about 550 Mva. Cables could be run directly to major distribution sites contemplated. A large portion of the ultimate expenditure could be deferred until later years, permitting the plan to fulfill better its ultimate objective of supplying the future distribution stations to be built as the need developed. An arbitrary limit of four terminations per line has been used to avoid operating difficulties because of complicated problems of switching and load division. Normally only three terminations are required to act as source and also as two loads.

Load Shape Considered . . . In combining several distribution stations upon a single group of subtransmission lines, consideration of the load shape may lead to substantial savings. A large commercial load of office buildings and stores may have a summer peak because of air conditioning that can be balanced by combining residential distribution having a winter peak on the same subtransmission system. One feeder can further serve as spare capacity for several stations. Use of two 69-kv lines to Substation 55 illustrates (Fig 2) the same principle of using subtransmission both for distribution and transfer of energy between power sources as used in developing the 33-kv system.

Most generating stations now being built are comparatively remote from load centers, and there is little need for local distribution at generator voltage. Even where local load may be supplied, it will be found necessary to impose some reactance between the generating bus and the distribution system to reduce otherwise prohibitive cost of switchgear for relatively low capacity distribution feeders. A study for generating station C showed that under these conditions, the use of a 69-kv bus with transformers in the generating circuit cost about $750,000 less for five units than a 13.8-kv bus with 13.8 to 69-kv transformers as an integral part of the subtransmission feeders.

Voltage Regulation . . . For supply of a low-voltage ac network system or large commercial customers, voltage must rise at peak time to allow for distribution transformer and secondary drop. In addition the control system must be sensitive since a gain of even one volt on a 120-v basis will show substantial savings in distribution transformer capacity and secondary copper required to maintain a given voltage that will be within acceptable limits.

For these reasons individual regulation in small steps is deemed necessary for each major distribution substation. This can best be obtained by tap-changing transformers. If a station is supplied by three transformers, the use of 2½% steps will provide about one volt change in voltage on a 120-v base if only one transformer tap is changed at a time. If the tap-changing portion of the winding is connected to lead the line-to-neutral voltage by 60 deg, it is possible to not only control voltage but also the kilowatt and reactive division between lines. This control is essential if lines originate at different power sources, have dissimilar characteristics, or require different load divisions for different system conditions.

Thus the load to be supplied by each transformer at Substation 12 will depend upon the load at Substation 55, the load at Substation 38, and the power transfer between generating stations B and C. This is accomplished without significant operating complications by tap-changing-under-load transformers of the type described.

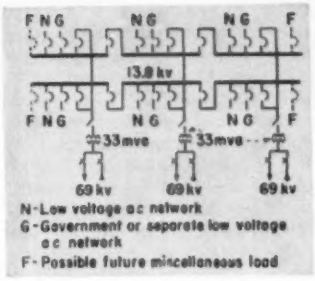


FIG 3—PROPOSED typical 13.8-kv bus for supply of low-voltage network loads. Distribution system allows simultaneous loss of one N and one G feeder without customer outage

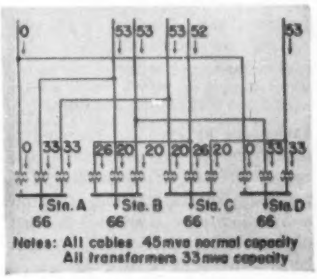


FIG 4—METHOD of load division among proposed typical lines under emergency conditions with a transmission line out of service

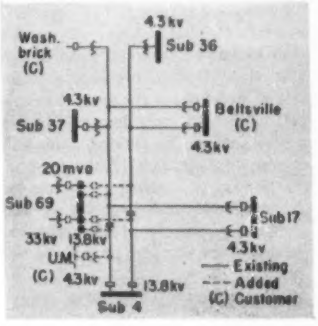


FIG 5—NEW 33-KV SUBSTATION in suburban area relieves load on major distribution centers and 13.8-kv distribution feeders

Type of Switching . . . A factor materially affecting the economic size of

the distribution station is the type of switching to be used. Studies based upon conditions in the Washington area show that industrial-type, metal-clad switchgear has approximately one-half the cost per circuit of central station-type cubicles or concrete cells. It is materially cheaper than outdoor oil breakers. Admittedly industrial switchgear will not have the equivalent reliability, but by providing adequate sectionalizing points and the use of magnetic or air blast breakers to eliminate oil fires, service to the ultimate customer can be made fully as reliable as with other types. As such switchgear is limited to a maximum interrupting capacity of 500 Mva at 13.8 kv, this places a premium on designing and loading the distribution substation to keep it down to this level of duty.

Impedance Effects . . . Assuming an impedance of the subtransmission system of 0.05 at 100 Mva, it is necessary that the transformers in the distribution substation have an impedance of 0.15 at 100 Mva in order not to exceed this value. Transformers having an increase in rating of 67% with forced-air cooling have a maximum impedance without additional cost of 16.7% and completely forced-oil-cooled transformers 15% on their nameplate rating. This will permit installation of a total capacity of 100 Mva. It then becomes a problem of working out the most economical number of units into which this capacity should be divided. This will require consideration of the ratio of the normal to emergency loading of the subtransmission capacity as well as the firm transformer capacity remaining after the loss of one feeder. Table II illustrates this relation of emergency to normal loading.

Cable Temperature Rise . . . For the three-conductor, gas or oil-filled cable, at least three days should be allowed for repair of a failure. During this time the temperature rise on the remaining cables should not be sufficient to cause excessive loss of life. The ASA "Guide for Loading Oil Immersed Distribution and Power Transformers" can be used to determine transformer loading. No such guide is available for cables, but an increased temperature of 5 deg C would be conservative. This would correspond to an increase in load to only about 5 Mva on a 45-Mva cable, which is too small to permit full utilization of normal capacity. Therefore, it is important that subtransmission cables be planned to minimize the ratio of emergency to normal load in order to decrease the loss of life expectancy.

Diversity Benefits . . . A station which fits well with the subtransmission system is shown in Fig 3. By connecting two transformers in different stations to a feeder, the maximum normal load would be 44 Mva or less, depending upon diversity. If no two feeders go to the same two stations, maximum load in the case of loss of one subtransmission cable would be 53 Mva (Fig 4). In cases where diversity is substantial or there is a diversity of hazard, it will be possible to use larger sizes of power transformers.

Examples of this would be the circuit in Fig 2 extending from generating station C to substation 12 and Substation 77 having a total 95 Mva in transformer capacity. These stations not only have a load diversity, but the load on any two of these transformers can be reduced sufficiently to limit the total cable loading to 45 Mva and deliver full capacity to any one transformer under the emergency of the loss of one cable.

Dead Load Pickup . . . Careful study of problems involved in picking up dead load may also have an important bearing upon subtransmission and major substation design. Using Fig 3 as an example, this problem can be greatly simplified by dividing the load into two or more electrically independent groups, as shown by the feeders marked N and G. By use of a central control system and selector switches, any or all of the feeders supplying one load may be closed simultaneously. The feeders supplying other loads may be closed after a time delay permitting reduction of the initial load.

An alternate method having advantages under some conditions would be simultaneously to close all transformer secondary breakers. This requires less control wiring, but the advantage of picking up the load by groups is lost. Problems of synchronizing different power sources also may be introduced by this method of pickup.

In the outlaying areas of the system a similar subtransmission development may be used, but on a smaller scale. In this case the subtransmission is generally overhead, and there will be no sharp break in the cost per kva up to the voltage where lines must be run on private right-of-way. In most locations this will be above 33 kv. Stations having two or three 20-Mva, 33-kv lines are used to form new major distribution stations. Existing 13-kv lines are cut and used to supply small 4-kv primary network substations and large customers. Fig 5 shows an application of this principle.

Table I—Comparison of Costs of Several Cables Used for Subtransmission

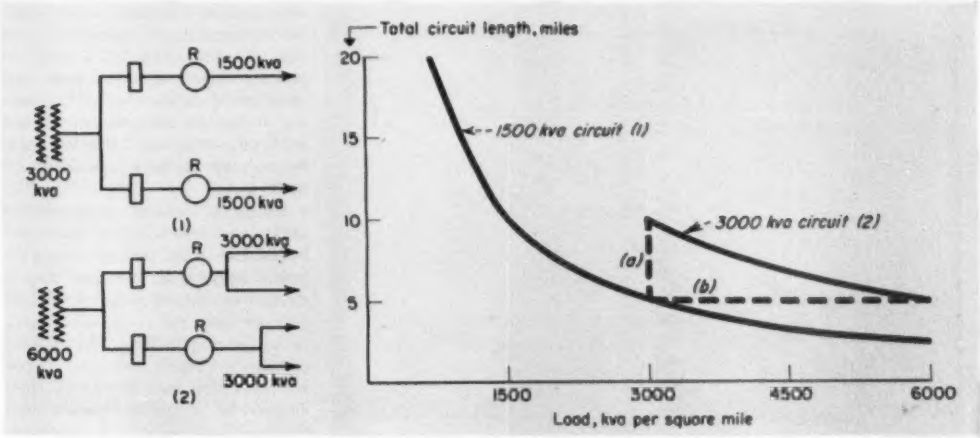
	34.5 Kv	69 Kv	69 Kv
Cable Size	500 Mcm	600 Mcm	300 Mcm
Conductors	3	3	3
Gas Pressure	Low	Medium	Medium
Mva Normal Capacity at 75% LF	20	45	30
Cost per cable per mile	$70,000	$84,000	$57,000
Cost of 4-way conduit per mile	120,000	130,000	130,000
Total cost for 4 cables and conduit	400,000	466,000	358,000
Cost per Kva per mile	$5.00	$2.59	$2.98

NOTES: Costs of conduit will vary radically with local conditions. Those given are for construction on city streets with many obstructions and heavy traffic. One factor affecting the above estimates is that all four 34.5-kv cables are routed through the same manhole, but with 69-kv cables only two appear in any manhole.

Table II—Ratio of Emergency Cable to Normal Loading

Stations per Cable	2 Cables per Station	3 Cables per Station	4 Cables per Station
1	2	1.5	1.33
2	1.5	1.25	1.17
3	1.33	1.17	1.11
4	1.25	1.12	1.08

NOTE: Values are based upon cables being interlaced so that no two cables have two stations in common. Values above could be reduced slightly by use of phase angle control.



LOAD INCREASES in an area may be met by increasing load on each 4.16-kv circuit in one of two ways: (a) by combining two smaller circuits or (b) by adding capacity at the source to carry the load increase on the existing circuit. Substations rated at 3,000 kva and 6,000 kva may be new standard ratings 2,500 and 5,000 kva, respectively, if loading and diversity are within permissible limits

Raising Distribution to 12 Kv Has Many Facets – Explore Them All

Residential area load increases may justifiably dictate retention of 4 kv. More load per circuit and per substation is a logical evolution. Tree situation is often the crux of the decision

FRANK E. SANFORD, Assistant Chief Electrical Engineer, Commonwealth Services, Inc, Jackson, Michigan

Experience with 7,200/12,470 and 7,620/13,200 volts for distribution in rural areas has added an important possibility for consideration in the planning for urban and suburban residential service areas. The higher voltages have been adopted in a number of cities, and an increasing use is indicated, especially in new development areas and in outlying and suburban sections.

The trend to more use of higher voltage does not, however, indicate the eventual replacement of 4.16-kv distribution. While there are conditions and situations which justify conversion to a higher voltage or a limitation of the area served at 4.16 kv, it appears that systems now established may be economically continued at this voltage.

4-kv Wye Capability . . . Use of 2,400/4,160-v wye with grounded neutral, which predominates in present urban distribution, has proved satisfactory for a wide range of load conditions. Its limitations in the past have been largely due to light load density; and as load densities increase, the principal problems of voltage regulation and exposure to causes of outages become relatively less restrictive in planning circuits. The huge investments in urban distribution are of great importance in considering any change in this general system.

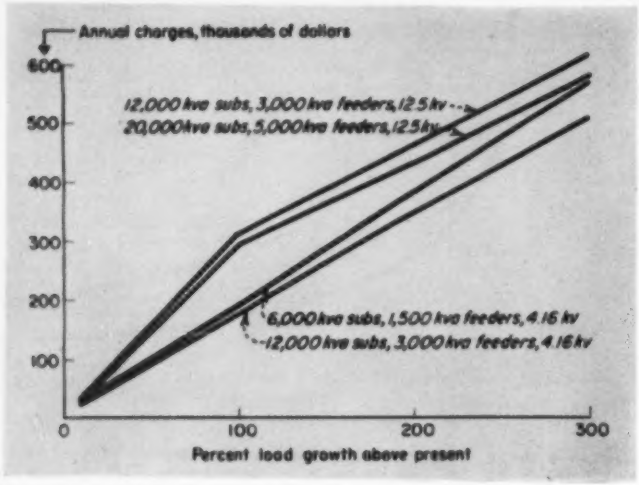
Advantages of Higher Voltage . . . In urban areas the principal economic advantage of higher voltage distribution compared to 4.16 kv is the possible reduction of the required number of substations, and associated subtransmission, by increase in the practical area of distribution and in the load supplied by each circuit and by each substation. Also:

1. The economics of distribution are closely related to the available power supply, and savings with 12.5 or 13.2 kv would be greatest where present subtransmission in the area may be used for distribution with circuit protection but without transformation.

2. Ability to extend distribution circuits to long distances in small towns or suburban areas may save parallel extension of subtransmission. This is especially true if surrounding rural areas may be served by extensions of the same distribution circuits.

3. Since original construction may be either for 4.16-kv or for 12.5 or 13.2-kv operation with a small difference in initial cost, the higher voltage may be advantageous for large housing development areas requiring extensive new distribution.

These conditions of advantage for higher voltage may not apply equally in cities requiring several substations because relatively short subtransmission extensions are necessary for new substation locations with either voltage. Each local situation must be



ANNUAL CHARGES on future cost requirements, plus losses, indicate how much more a changeover to a higher distribution voltage would cost than continuing to operate at 4.16 kv

considered. And these obvious advantages must be evaluated, along with consideration of operating and tree conditions, in reaching a decision.

Higher 4.16-kv Loading . . . As load densities served at 4.16 kv increase, the advantages of larger substations may also be obtained with continued operation at this voltage. Load ratings of individual circuits have been limited by primary voltage regulation, which is determined by conductor sizes in general use, distances from supply, and the average densities of load. Continuity of service and exposure of each feeder to causes of outages have been other major limiting factors in the length and resulting load carried.

Voltage regulator ratings in most general use have been increased from 150 amp to 200 and 250 amp, with a smaller use of 300 amp, resulting in average nominal ratings of 1,500 or 1,800 kva for each circuit. As load densities have increased, new substations and additional circuits have been installed.

Amount of line and service area of each circuit also has been reduced to average one-half or one-quarter the values which prevailed when the present ratings were adopted. As load densities increase to again double existing values, it may be possible to increase the nominal load ratings of equipment and circuits.

Bus Regulation . . . Bus regulation, or supply of two or more circuits through one regulator, has been used to some extent for circuits of similar length and load. This arrangement will become more practical as load densities continue to increase. The next step in this general direction is to supply more load through each circuit position. Circuits rated 2,500 or 3,000 kva for supply in areas with load densities of 3,000 kva per sq mile and higher are comparable in length with circuits rated 1,500 or 1,800 kva in areas having a load density of 1,500 kva.

Larger or parallel conductors or cables are necessary for short distances out from the substations to points where main overhead branch circuits can be connected to extend over diverging routes. In effect, each circuit position in the substation may continue to supply the same circuit and increasing load in its area, with an increase in capacity rather than by division of the circuit and installation of a new circuit position. (See accompanying diagram).

Changeover Costs . . . Conversion of an existing 4.16-kv system for operation at 12.5 kv necessitates changing all substation transformers and part of the other equipment and bus arrangement. On the circuits, crossarms, insulators, and pins on all poles usually must be changed, and all transformers and accessories must be replaced. These costs, especially in the substation changes, will be considerably higher than for equivalent new work because of the necessity to maintain service during the period of reconstruction.

Gradual replacement over a long period of years will tend to reduce the total cost directly chargeable to the change. However, the apparent saving may be to a large extent offset by the greater total amount of 4.16-kv equipment which will be changed eventually, with construction of this voltage continued for load growth in the longer period.

Comparison in Typical Area . . . Average conditions of urban residential area distribution are well represented in a 17-sq mi area of a midwestern city selected for analysis of costs and a comparison of plans to continue 4.16 kv or to change to 12.5 kv. Four substations with supply at 23 kv have a total undiversified peak load of 22,000 kva.

Load density averages about 1,500 kva per sq mi, varying from a maximum of 3,400 kva to a minimum of 900 kva per sq mi. The section includes an area of large homes, some apartment buildings and shopping

Future Cost Requirements of Conversion

Distribution Voltage	Load Increase Percent	Distribution	Substations	Transmission	Total
2400 4160 v					
6,000-kva substations	100	$650,000	$560,000	$40,000	**$1,250,000**
1,500-kva circuits	200	650,000	560,000	30,000	**1,240,000**
	300	590,000	590,000	40,000	**1,220,000**
12,000-kva substations	100	680,000	460,000	10,000	**1,110,000**
3,000-kva circuits	200	670,000	390,000	30,000	**1,090,000**
	300	590,000	460,000	30,000	**1,080,000**
7200 12,470 v					
Initial Change		730,000	390,000		**1,120,000**
12,000-kva substations	100	640,000	390,000	10,000	**1,040,000**
3,000-kva circuits	200	650,000	390,000	30,000	**1,070,000**
	300	640,000	390,000	10,000	**1,040,000**
20,000-kva substations	100	630,000	310,000		**940,000**
5,000-kva circuits	200	650,000	350,000	10,000	**1,010,000**
	300	640,000	340,000		**980,000**

centers, and smaller homes in the vicinity of an industrial area consisting of a number of small plants.

There is a total of 160 miles of pole line with 60 miles of three-phase circuit, 10 miles with two-phase wires and neutral, and 90 miles of single-phase branches or laterals, resulting in an average of about 10 miles of ratio of about 60% single-phase pole line per sq mi of area and a branches to total line miles. There are approximately 1,700 distribution transformers and an estimated total of 7,000 poles in this section.

Laid Out for Increase . . . The area was laid out for location of substations and distribution circuits on the basis of a uniform increase of load density for 100%, 200%, and 300% above present loads in each sub-area. Four plans were included:

1. Continued use of 4.16 kv, with nominal substation ratings of 6,000 kva and 1,500 kva (or 1,800) circuits.

2. Continued use of 4.16 kv with 12,000-kva substations and 3,000-kva circuits.

3. Change to 12.5 kv with 12,000-kva substations and 3,000-kva circuits.

4. Change to 12.5 kv with 20,000-kva substations and 5,000-kva circuits.

Future cost requirements for items which will differ from the plan followed were included in the estimates to provide for load growth. Subtransmission construction was estimated for the new substation locations, but additional subtransmission capacity and bulk power supply to the area, common to any of the general plans, were not included in the cost comparison. New and increased capacity feeder sections adjacent to substations are major items in the new line construction.

The costs of converting present lines and transformers to 12.5 kv were estimated at 50% above new construction unit costs. Pole replacements were not included, on the assumption that the number required for new feeder sections at 4.16 kv would approximately balance changes for increased clearances at 12.5 kv. Salvage value of equipment removed was estimated at 25% of original cost.

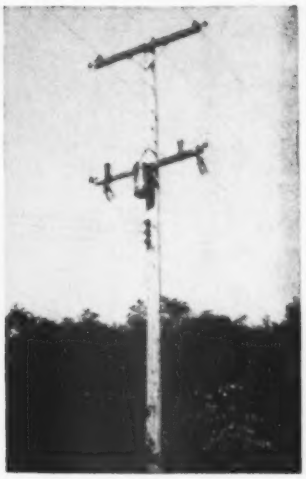
Annual Cost Comparison . . . The total annual charges at 14%, plus losses, are higher for either 12.5-kv plan to meet load growth than for either 4.16-kv. This period of higher costs for higher voltage will extend further into the future. (See curves).

Initial costs for conversion of this established distribution system to higher voltage operation are so large in relation to the possible savings that this investment dominates the further economic comparison. These costs, even if salvage value of equipment removed should be allowed at the original cost, would result in annual charges for the most favorable 12.5-kv plan higher than for the higher cost 4.16-kv plan during the period of load increase to 250% above the present load. This period of load increase may be 15 to 20 years.

Loss costs for 4.16 kv were estimated at 1¢ per kwhr for 2% peak loss on 50% load factor applied to the undiversified total demand in the area. Losses at 12.5 kv were estimated at 25% of the 4.16 kv rather than a value closer to one-ninth. This figure for losses was chosen after consideration of the relative sizes of conductor which would be used.

Tree Conditions . . . Tree conditions may be a principal determining factor in reaching a decision between the two voltages if total and investment savings are nearly in balance for a particular distribution system. Limb clearances and contacts are much more critical with 12.5 kv and trimming for lines through trees must be maintained on a closer basis than with 4.16 kv.

It is probable that the use of aerial cable construction will continue to increase in many tree areas. Costs are about equal for equivalent kva ratings at the two voltages where large loads are involved; but for single-phase branches, which account for a major part of the primary line mileage in residential areas, the cost of cable construction will average 50% higher for 12.5 kv than for 4.16 kv.



Tree problems are met . . .

on 4.16-kv systems by cable run through and under trees, a practice gaining acceptance; on higher voltages by use of high poles, a practice losing favor due to increasing costs

For average city distribution, it is concluded that:

1. A study and comparison for a suburban area or for a new development area is not a competent basis for raising primary voltage in a larger section with established distribution.

2. Consideration of a possible change in distribution voltage must include a realistic view of the broad base of existing investment and must recognize the cost of obsolescence.

3. It is probable that many distribution systems will have areas using 12.5 kv adjoining areas with 4.16 kv, both developed for maximum economy for the conditions.

4. Tree conditions, rather than other comparisons, may determine continued urban use of 4.16 kv or resort to higher voltages in different sections of the country.

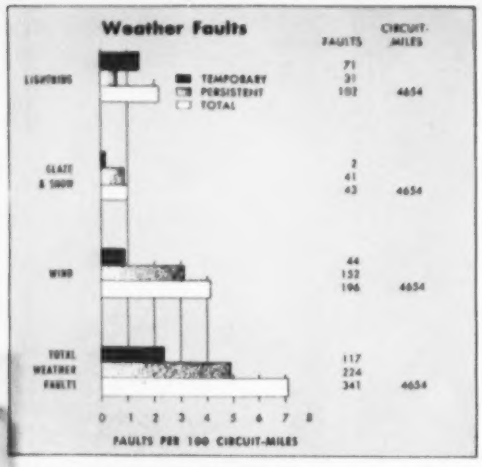


FIG 1—WEATHER FAULTS classified by initiating causes show that wind was major factor. Trees were involved in 47% of weather faults

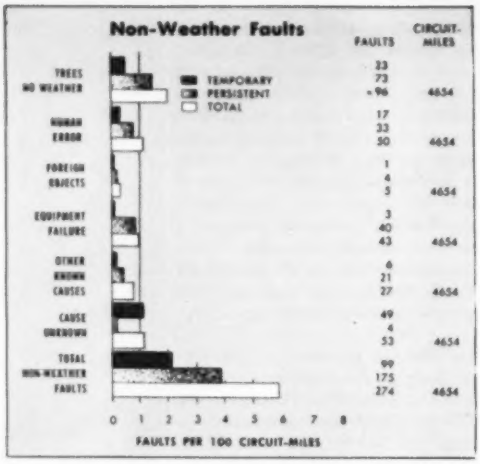


FIG 2—NON-WEATHER FAULTS classified by initiating causes show that trees and human error are significant factors

Distribution Design Should Be Based

$8 billion will be spent for distribution in the next decade. Common sense dictates analysis to ferret out which designs give best performance at lowest outlay

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G. B. DODDS, Duquesne Light Co, Pittsburgh

Type of design which might be expected to result in the lowest over-all cost for a given degree of distribution service continuity has been pretty much a matter of opinion. The industry has lacked any accepted measure of performance which could be used for broad comparisons of the various types of design.*

$8-Billion Investment . . . Distribution investment of privately owned utilities in the United States is now in excess of $8 billion. It constitutes well over 40% of the plant investment of these utilities. At the rate the industry has grown in the last 10 years, it is not at all unreasonable to expect that this investment will have to be doubled in the next 10 or 15 years on the basis of present costs.

It is just good business before making an $8-billion investment to analyze the performance of present facilities to determine which of the numerous types of design have given the desired degree of service reliability at the lowest cost. If as a result cost of future distribution systems could be reduced merely 2% without decreasing the desired degree of service reliability, the total savings would be in the neighborhood of $160 million. Cost of collecting, and interpreting data is almost insignificant by comparison. Admittedly there are numerous variables to be considered, and the very minimum amount of data necessary to carry on the study seems at first almost prodigious.

Scope of Study . . . In the study being carried on, 32 companies are submitting general construction, protection, fault, and weather data on 2 each of typically urban, suburban, and rural distribution circuits of 5 kv or less. The data for the year 1949 have been analyzed. They include faults occurring on 173 circuits involving 4,654 circuit-miles spread throughout the United States and part of Canada. Each fault encountered on these study circuits for the year 1949 was investigated and reported in detail.

Results of 1949 are published in detail in AIEE Miscellaneous Paper 52-13. The total results of this AIEE report are too lengthy to cover in this article, but some of the highlights of the report can be given. In considering these highlights the terms "temporary faults" and "persistent faults" should be defined.

Faults Defined . . . A *temporary fault* is one that is self-clearing within a few minutes, or which is cleared automatically by a clearing device such as a fuse without requiring line work for restoration of service, other than fuse replacement, or reclosing an automatically opened switching device.

A *persistent fault* is one which requires repair work on the line, other than either replacement of fuses, or reclosing an automatically opened switching device before service can be restored.

* Realizing this, the Relay, and Transmission and Distribution Committees of the American Institute of Electrical Engineers sponsored a study of the "Coordination of Construction and Protection of Distribution Circuits." The Transmission and Distribution Committee of the Edison Electric Institute was later asked to collaborate and furnish actual operating data from companies represented on the Committee. The Joint AIEE-EEI Working Group was formed with the authors as co-chairmen.

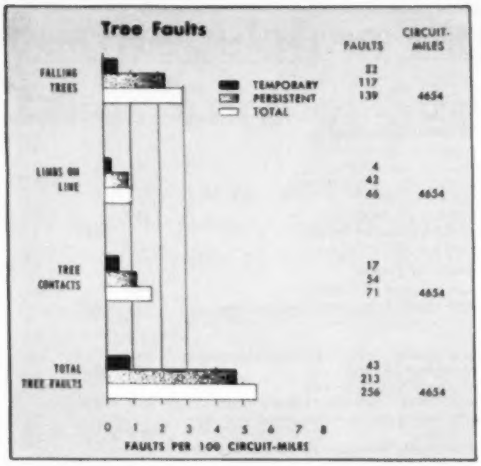


FIG 3—TREE FAULTS classified by types include weather and non-weather faults. In 54% of cases, trees actually fell on lines

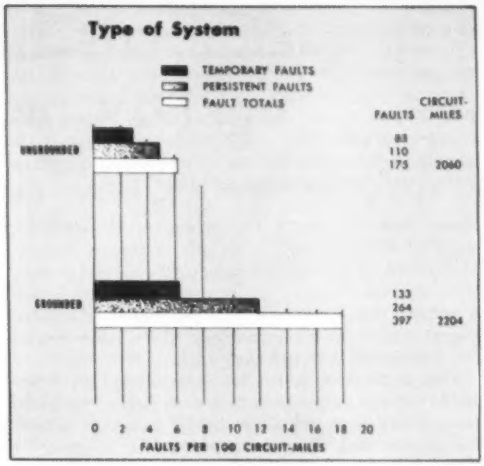


FIG 4—FAULT TOTALS classified by type of system show that ungrounded systems suffered less from the effects of lightning and wind

on Distribution Performance

Weather Primary Culprit . . . Weather proves to be the major factor causing distribution line faults. Of the weather faults wind seems to be the greatest contributor. Of 341 weather faults wind was involved in about 57%, lightning in 30%, and glaze in 13% (See Fig 1). A large portion of the lightning faults were temporary however (70%) while most of the wind and glaze faults were persistent. Trees were involved in 47% of the weather faults.

Of the non-weather faults the largest cause is trees, although failure of line equipment is significant (Fig 2).

When total tree faults, both non-weather and due to weather, were analyzed, they constituted 41% of all faults reported. Figure 3 shows that in 54% of these cases trees actually fell on the lines. In the other cases, tree limbs fell on the line or trees made contact with the line.

Is Tree Trimming Adequate? . . . This raises the question whether the industry is doing an adequate job of tree-trimming. Locating circuits along routes relatively free of trees might be cheaper and better than building along highways.

There were over twice the number of faults per 100 miles on the grounded systems as on the ungrounded systems (Fig 4). Faults from both lightning and wind were consistently fewer for ungrounded circuits than for grounded circuits.

As to tree faults, the experience was practically the same for the two types of systems for urban and suburban areas combined, but the performance of the ungrounded system appears to be much better for the rural areas (Fig 5). There was less tree trouble in the rural areas for either type of system.

Grounded or Ungrounded . . . Relative merits of grounded and ungrounded systems certainly deserve much more study. There are substantial investments in both types of systems in the industry, and for a specific set of conditions one system probably gives better performance than the other. However, as the data on which to form judgments is still very limited, this becomes one objective for future study.

For varying conductor nominal spacings, faults per 100 miles of circuit seemed to be about the same for lightning and for glaze or snow. But for wind faults with the 14½-in. nominal spacing, the performance was very much poorer than for greater spacing.

Effectiveness of protective devices in clearing faults depends on their ability to clear temporary-by-nature faults sufficiently fast to prevent them from developing into persistent faults. "Temporary-by-nature faults" are taken as those that may be cleared before conductors burn down if sufficiently fast operating devices are used. Examples are faults caused by lightning, conductors blown together momentarily but not wrapped together, trees blown into momentary contact with conductors, etc.

Faults cleared were divided into two groups: (1) Those that were persistent-by-nature, and (2) those that were temporary-by-nature.

Objective of a protective device on persistent-by-nature faults is (1) to isolate and clear them so that a minimum amount of circuit is interrupted and (2) to de-energize faulty equipment.

On temporary faults, however, the protective device should be able to clear the faults sufficiently fast to prevent the fault from becoming persistent and thus preventing the circuit from being restored to service immediately.

If a fault is persistent-by-nature, such as a tree breaking a wire, foreign objects on the line across conductors, or truck or auto breaking poles, there is no possibility of

returning the circuit to service regardless of the time of clearing the fault.

However, if the fault is initiated by lightning, by wind swinging conductors together (but the conductors do not wrap), by wind blowing trees into momentary contact with conductors, etc, the speed of clearing these faults is important since there is a possibility of restricting the amount of damage so that the circuit can be returned to service without repairs being necessary.

Fault Totals . . . Of the 173 circuits represented in the study, 57 are rural and 116 are urban-suburban. Circuits having 60% or more of their total length in rural territory were classified rural, all others were classified as urban-suburban. Data on these circuits relating to total miles, the number of faults occurring, and faults per 100 miles are given in the table opposite.

These data show that faults temporary-by-nature outnumbered those persistent-by-nature. Temporary-by-nature faults on rural circuits were slightly greater in number and percent than those on urban-suburban. Percent of faults which were temporary-by-nature and which remained temporary was a great deal higher for rural circuits than for urban-suburban circuits. Of all temporary-by-nature faults, 60% remained temporary.

Effective Protection . . . Figure 6 shows graphically the effectiveness of different types of protective devices, such as time-delay relays, instantaneous relays, reclosers, in clearing faults of a temporary nature sufficiently fast to keep them from becoming permanent.

On urban and suburban circuits (where 1,137 miles of the 1,518 miles involved were covered wire) automatic reclosers, while clearing only 5 faults, had a record of 100% in keeping them temporary, single shot fuses had a record of 84%, instantaneous relays 73%, time delay relays 54%. Average for all types of devices was 68%.

On rural circuits (where 2,180 of the 3,136 miles involved were bare wire) most of the types of protective devices were fairly efficient with the automatic oil circuit recloser leading with 92.3%, time-delay phase relays 85.6%, line shorters 85%, instantaneous relays 80%, single-shot fuses 70%, and two shot fuses 50%, with all types of protective devices having an average of 76%.

It should be remembered that the above is not the relationship of faults remaining temporary to total faults but is the relationship of faults remaining temporary to the faults that originated temporary by nature. It is believed that this latter ratio is the proper measure of the effectiveness of protective devices in keeping faults from becoming persistent.

Perhaps one of the greatest dangers in making a study of this kind is that of arriving at definite conclusions too soon. There are many questions to keep in mind when collecting the data. Some of these are:

1. Under what conditions should bare wire be used and where should covered wire be used?

2. Under what conditions should an ungrounded system be installed? A grounded system?

3. What is the optimum spacing for different voltages and types of construction?

4. Should the industry take a long range viewpoint of the tree problem? Should advertising and other public relations media be used to encourage planting of smaller types of trees and to induce property owners to plant trees where they will not interfere with effective distribution?

System Characteristics and Temporary Faults

	Urban-suburban	Rural
System Characteristics		
Number of circuits	116	57
Bare wire, circuit-miles	381	2,180
Covered wire, circuit-miles	1,137	956
Total circuit-miles	1,518	3,136
Number of faults	**329**	**330**
Total number of faults	**659**	
Faults per 100 circuit-miles	21.7	10.5
Nature of Faults		
Faults temporary-by-nature	189	220
Total faults temporary-by-nature	**409**	
Faults temporary-by-nature in number of faults	57.4%	66.7%
Total faults temporary-by-nature in number of faults	**62.3%**	
Faults remaining temporary	91	156
Total faults remaining temporary	**247**	
Faults temporary-by-nature remaining temporary	48.2%	70.9%
Total faults temporary-by-nature remaining temporary	**60.4%**	

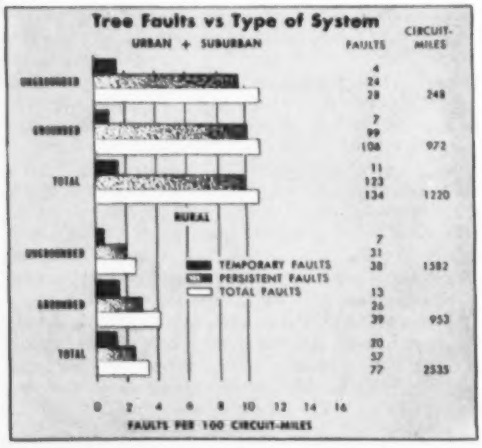


FIG 5—TREE FAULTS—Classified by type of system. Circuits of less than 80% of area not included. Faults per 100 circuit-miles

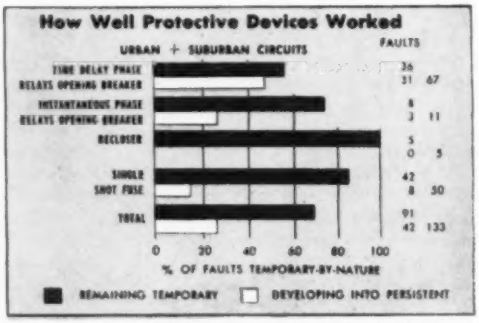


FIG 6—EFFECTIVENESS of protective devices in keeping faults temporary which were temporary-by-nature is shown in the chart above

Bus Regulation Plus Capacitors Takes Care of System Voltage

Generator bus regulation in conjunction with switched capacitance economically improves voltage regulation and enhances effectiveness of all present facilities

D. R. PATTISON, Chief Electrical Engineer,

F. M. REED, Assistant Electrical Engineer, Pennsylvania Electric Co, Johnstown

Early generators, which usually supplied single circuits or radial systems, often were compensated for load variations in such a manner that their terminal voltage varied with the load. Ac generator regulators compensated for both IR and IX drop to some distant point on the feeder circuit. Later, when numerous generators were tied together through transmission systems, it became customary to hold a constant voltage on the generator bus and to depend on regulation farther out on the system. This was usually at the distribution substation level to improve voltage regulation on the distribution feeders.

These regulators were often of the induction type which created a reactive component that pushed voltage down toward the generator in order to increase it at the load. They were often compensated to increase voltage with load at their terminals in order to compensate for variations in voltage drop farther out on the feeder circuit. The regulator thus took over in a fashion the function of the old time generator with its load compensated regulator, and at a decided loss in efficiency.

Bus Regulation . . . With such a method of regulation, voltage falls from generator toward regulator. The greatest differential occurs at full load when the regulator must compensate for this voltage drop as well as for that resulting from its own reactive. It is just as beneficial to compensate at the generator through a band in proportion to the load if such manipulation does not create other problems.

Induction regulator methods result in constant voltage at the generator and maximum regulation as the regulator is approached. On the other hand, generator bus voltage regulation results in the maximum inverted regulation at the generator with minimum at some point farther out in the system.

Because of the higher voltage level maintained by the generator and the primary distribution circuits at full load and because no lagging reactive component is introduced by regulators, a given voltage range at a generator is equivalent to considerably more than that which would be obtained by a regulator with the same range.

Simple, Economical . . . The principal advantages of generator bus voltage regulation are its extreme simplicity and the elimination of initial cost and operating expense of regulators. It is so uncomplicated that the natural reaction to it is that it has been much over-simplified in theory and cannot possibly cover all situations. The fact is, however, that a voltage swing of 8½ to 10% on the generator bus varying directly with system load has been very satisfactory. No matter what combination of voltages is supplied from the source, regulation on each circuit is greatly improved.

In one case a generating station feeds directly into an 11-kv network system as well as through transformers into a 33-kv system and via the 33-kv system to the 110-kv system. The regulation on the 11-kv network is satisfactory, and the voltage swing is equally beneficial to the 33-kv and 110-kv systems. There is no need for creating various degrees of voltage swing on various voltages because, in general, the relative electrical distances times loads are of the same order to the load center on any voltage.

No Effect from Scheduling . . . Generating stations thus become points of fixed voltage with respect to load. Variations in generating load schedules for given system loads have little effect. The reason is that with a decrease in energy generation a compensating flow of reactive component from the generators is maintained to the system. This flow holds voltages on the various circuits supplied by that station at substantially the same level as with normal generation.

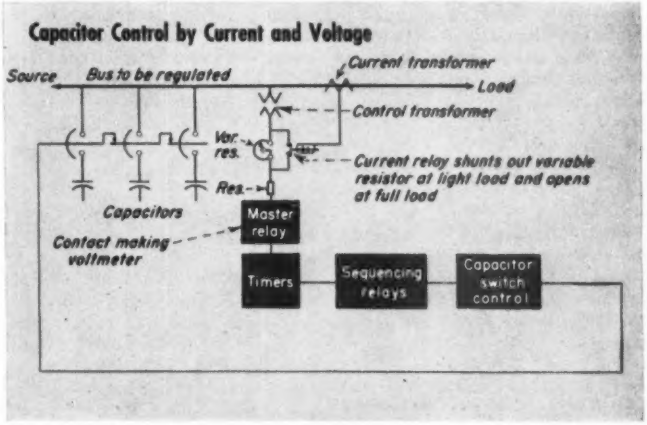


FIG 1—ESSENTIAL FEATURE of current-voltage control is voltage control with current element injected to vary control range to meet conditions during full load and light load

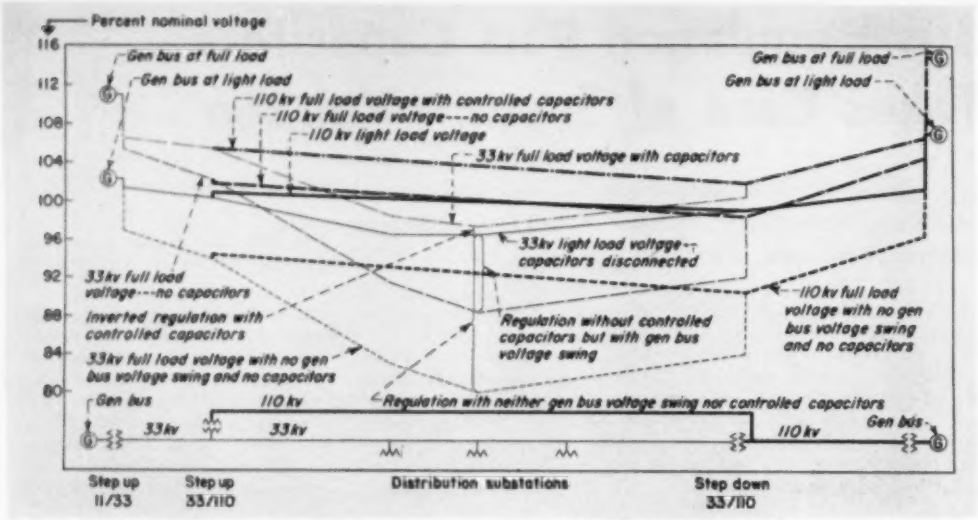


FIG 2—SYSTEM VOLTAGE is controlled by generator-bus voltage regulation and distribution capacitors with current-voltage control. With respect to load, fixed voltage is at generator bus. Circuits at each voltage tend to regulate the circuit with a higher voltage

The result of this system of regulation is virtually the same as if all of the circuits supplied by each generating station had TCUL transformers on which the taps were changed with the system load rather than with the local circuit load.

This method of varying voltage with system load is of advantage in the common situation where the circuits of various voltages fed by a generating station are interconnected at various substations. With changing generating schedules or with line outages, etc, if the automatic compensated TCUL equipment were used, the load at the feeder transformer would change giving rise through load compensation to varying voltages under given system load conditions. On the other hand, if generator bus voltage is scheduled with system load, loading on local radial circuits of any size usually follows system loading. Therefore, the compensation is satisfactory.

Voltage Up on Peaks . . . The result of this voltage swing—in the case of Pennsylvania Electric Co amounting to 8½ to 10% on major stations—is to bring voltage on circuits served through step-up transformers about 7 to 8% higher on peak than at light load at these locations. If this method of controlling regulation were used alone, the regulation at various points on the system would vary from the above maximum inversion to virtually zero at more distant locations, and normal voltages would be lower at full load than at light load at the most distant points. Since these latter locations would in many cases have regulation beyond possible tolerances and would require additional regulators of some type, automatically controlled capacitors have been installed.

These serve as a perfect auxiliary to generator bus voltage swing, and by their aid the regulation at any distribution bus can be brought to any desired amount or even inverted, which is usually considered to be desirable. In conjunction with generator bus voltage regulation they make regulation of any other type entirely superfluous, and the two working together minimize the required amount of either for a given required regulating effect.

Control Necessary . . . It is necessary for the capacitors to be controlled by some means other than voltage alone. This is so because as generator bus voltage rises with increasing load and as capacitors are connected to the circuit the voltage rise would tend to hold capacitors off. Conversely as generator bus voltage drops at light load, it would tend to bring capacitors on, which is the opposite effect from that desired. Therefore, it is necessary to add a current element to the control which gives a high range to the voltage element during full load periods and a lower range during light load periods (Fig 1).

This arrangement also has another use as it permits the capacitor to be brought on the line if light-load voltage falls below the low range value at which the control has been set. This current-voltage control scheme is distinctly not a kilovar or power factor control scheme but is essentially voltage control with the current element electrically separate but used to vary the range of the voltage element with changes in load conditions on the circuit.

With automatically controlled capacitors on at full load and off at minimum load, the voltage drop at full load between generating station and distribution circuits is reduced. The regulation at every point between generating station and capacitor is also reduced.

Improvement in regulation on any circuit is merely a matter of adding enough capacitors on that circuit to meet the desired limits of regulation.

Help Whole System . . . Capacitors help to improve regulation on the entire connected system. They relieve transformers of reactive load and increase the capacity of generators to supply adequate reactive component

when a generator is out of service. They relieve distribution and transmission circuits of reactive load. Thereby they make it feasible both from the standpoint of economy and from the standpoint of regulation to replace conductor with larger conductor when required and to build new lines with larger conductor than would otherwise be practicable.

Self-regulating . . . Generator bus voltage regulation and automatically controlled capacitors at the loads afford a system that regulates itself under varying conditions of loading, generation, and circuit arrangement to a degree that could not be approached by manipulation regulators. Furthermore, it will carry much heavier loads with good regulation than it would with regulators alone.

The entire system rises in voltage as load increases. Fixed voltage points with respect to the load are at the generator buses. Circuits of each voltage tend to regulate the circuit with a higher voltage for all conditions (Fig 2). For instance, consider a high-voltage line which varies widely in its loading conditions and is tied into a lower voltage system at one or more points. The automatically controlled capacitors at the lowest voltages will hold the required level on the lower voltage system and will actually regulate the voltage and var load on the high voltage line by reducing its var requirements when it is loaded and increasing them when it is not loaded.

Surpasses Tap Changing . . . This effect greatly increases the capability of the high voltage circuits and is exactly opposite to that of regulators or TCUL equipment between the high-voltage and low-voltage systems. The latter tend to limit the capability of the high-voltage line. This is because when load and var requirements in the low-voltage system are high, these var requirements are transferred to the high-voltage line and tend to cause an excessive voltage drop especially if the line is already heavily loaded.

Regulators or TCUL equipment are thus not effective in maintaining voltage in the low-voltage system when the high-voltage circuit is heavily loaded. Also, when lower effective transformer ratios are needed to maintain this voltage at one location, they are usually needed at other locations. The voltage drop in the transmission line largely offsets the effect of the regulating equipment which progressively loads up and lowers voltage in the transmission circuit as the regulators attempt to raise voltage in the lower-voltage systems. This is particularly true as length of the high-voltage circuit and the number of connections from it to lower-voltage systems increases.

Double-line Behavior . . . Another major saving arises from the characteristics of the capacitor. Where two or more circuits feed an area, the capacitors will increase their voltage rise when one line is out of service. This is because the voltage rise due to the capacitors is a function of the reactance to the source. Therefore, when a line outage occurs the increased reactance provides a corresponding increase in voltage rise due to the capacitors. They thus give better regulation in the area than an additional circuit even though they are normally on the line under full load conditions. Also the current-voltage control makes them available for this emergency service at all times.

Two Methods Compared . . . Generator bus voltage regulation and automatically controlled capacitors give a smooth and continuous rise on the system from capacitor to generator bus. On the contrary, conventional voltage regulation gives a sharp voltage differential at each regulator which becomes more pronounced as loads increase. Voltage at points ahead of the regulator are not benefited by it while it is correcting voltages farther out the line. This creates a complex problem that must be compromised in a system that is composed of circuits of several voltages that are tied together at numerous points. This is particularly so when loads are fed from circuits on both sides of the regulators.

Objections to Capacitors . . . Two objections to voltage control by capacitors are often advanced:

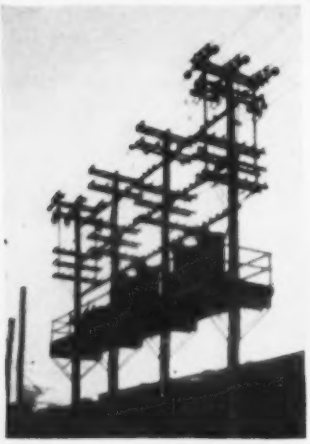
1. The voltage steps that are necessary are too great.
2. Large voltage differential cannot be overcome by capacitors.

The first is answered by the fact that the voltage rise created by the capacitor is a function of its size and also of the reactance or distance to the source. Either or both of these factors may be so controlled as to give the size of step required by conditions on any circuit. Furthermore, whatever voltage steps are established on any particular circuit, the resulting system rise at all points ahead of the capacitor is quite small. And the resultant system-wide rise for any appreciable quantity of the capacitors is in very small increments as load increases on the system.

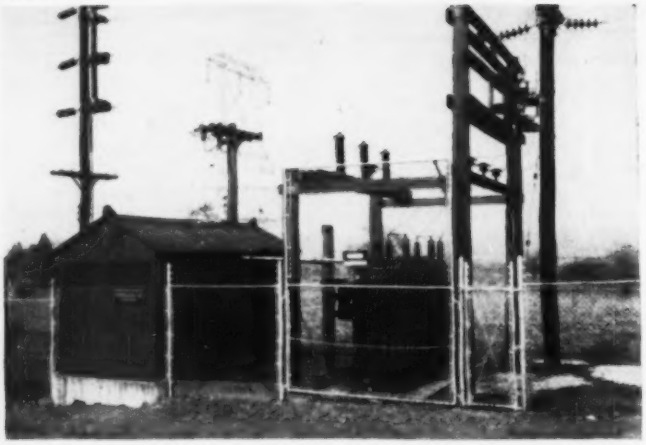
As to the second question, the total differentials in voltage that can be offset by capacitors are in practice greater than those permissible with the conventional regulators because of such limitations on the latter as that discussed in a previous paragraph.

Will Add 50% More . . . Pennsylvania Electric Co has 85,000 kvar of automatically controlled static capacity on its system with a peak of 461,820 kw. Within the next year it will have 125,000 kvar.

CURRENT-VOLTAGE CONTROLLED 540-kva capacitor units in a substation go on at full load and off at light load to reduce regulation at every point between generator and capacitors



LOW ESTHETIC VALUE marked conventional platform substation of pre-unit era



MUCH FIELD LABOR was required in the installation of first substations. Hardly any two fenced-in substations were alike which meant that salvage recovery value was low

Drawbacks of Old Substations . . .

Philadelphia Electric Co finds new equipment is easy to install, can be expanded if necessary, and has a high salvage value. Public likes its appearance and quiet operation

G. S. VAN ANTWERP, Manager, Transmission and Distribution, Philadelphia Electric Co, Philadelphia, Pa.

Unit substations were developed as an escape from the many disadvantages which accumulated from the use of the older designs of small regulated substations. These substations were assembled in small enclosures or on pole platforms to serve the many load centers which were still too small to justify the conventional multi-circuit substations.

Some of the disadvantages encountered were:

1. The substations were constructed in a piecemeal manner, utilizing the widely assorted equipment available which was difficult to correlate and interconnect.

2. Each substation was different and could be operated by only a limited number of men familiar with the individual installations.

3. The substations were eye-sores, resulting in adverse zoning restrictions on subsequent construction.

4. The installations were expensive because of the large amount of field work needed to install and maintain the substations.

5. Low salvage value made such installations uneconomical for short-time use or even for 3- or 4-year periods while system plans were being developed.

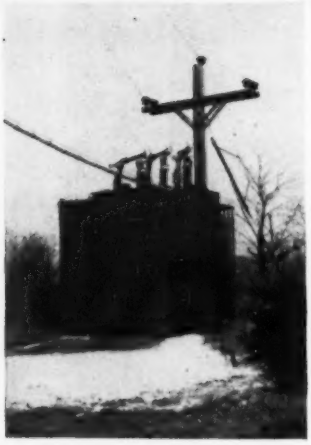
Unit Substation Design . . . To better this condition, a so-called unit type substation was developed. The unit had all necessary equipment in one tight metal enclosure and performed all functions of a regulated step-down substation with automatic protection. The unit contained main transformers in oil under gas pressure, high-tension lightning arresters, and protective fuses. Additional features were voltage regulation by tap changing under load and an outgoing circuit breaker with all necessary controls. The device can be picked up by a mobile crane and transported on a trailer truck over the average city street or country road.

Applications of Units . . . Individual units can be installed as a temporary expedient to improve the voltage of a long distribution circuit. They can also be installed to supply a power load which develops beyond the capacity of the existing circuits. Several units can be grouped to form substations supplying several distribution circuits.

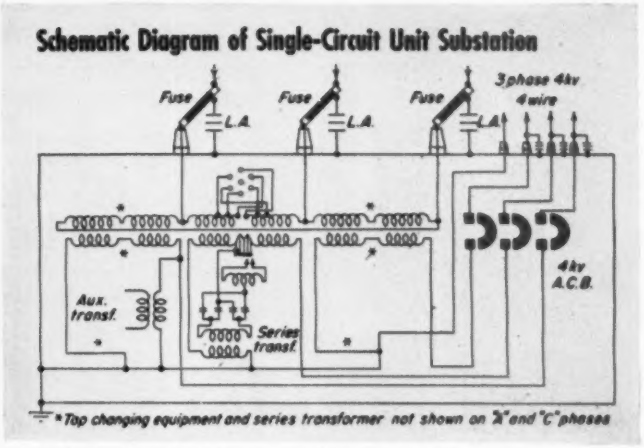
A group of units now known as a duplex type substation can be arranged to give a continuity of service equaling that of a city substation. This arrangement requires two transmission lines, one to act when the other fails, or a loop circuit breaker in the high tension line so one section of the line can remain energized if the other section is out.

Public Approval . . . Unit substation installations can be made in residential areas. The connections to existing lines can be made either with open wire or with overhead and underground cable. The area surrounding the equipment can be landscaped with trees that in many cases render the installation scarcely visible from the highway or adjacent residences. When shown examples of the type of installation proposed, the public has accepted them with much less resistance than originally encountered.

Length of time required by the field forces to install substations is short, and this appeals to the public because traffic congestion during the construction period, truck



FACTORY-ASSEMBLY has largely overcome demerits of substations erected piecemeal



SELF-CONTAINED unit substation encloses main transformers, high-tension lightning arresters, and protective fuses. Substation can be picked up as a unit and carried on a trailer

Give Way to Merits of Unit Types

loads of material, parked cars of the workmen, and the general unsightliness of construction are all minimized.

Unit type substations have an added advantage in public approval insofar as they are very quiet in operation. They do not emit the hum of older types of transformers and the click-clacking of induction voltage regulators and associated gear.

Unexpected Advantages . . . When the units were developed, the emphasis was on appearance and simplicity of installation. Other unexpected advantages have become evident after placing the units in service.

The high salvage value permits a unit to be moved with loss of only the small amount of labor going into preparation of the simple foundation and connection of the lines. There is increasing need to move units in conjunction with widening highways and the rapid development of new communities.

Ease of replacement has simplified major repair work. Load conditions are promptly returned to normal and the faulty unit is then available for unhurried repairs. After repair it becomes a spare.

DUPLEX ARRANGEMENT is comprised of four 1500-kva units. Feeds to and from stations are entirely by underground cables

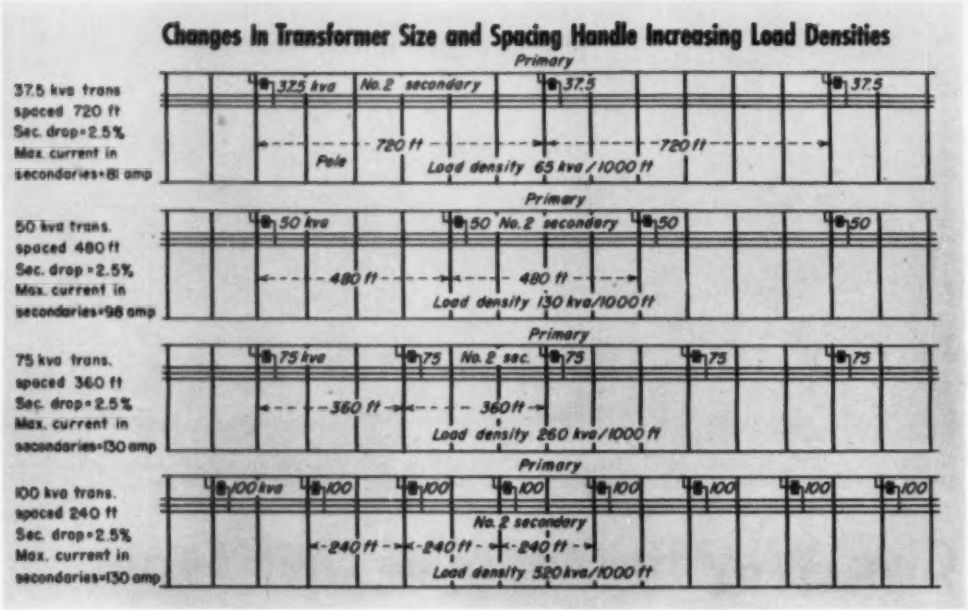
Employees Trained . . . Standardization of the design of the units has made it possible to prepare a training course for employees called upon to operate the units. This will result in a large number of trained men, prepared to make adjustments and necessary field maintenance on the units. In addition, switching and blocking circuits has become standardized. Whenever a question arises in the field, the operator can discuss the problem with the dispatcher by radio or telephone. The dispatcher can refer to enlarged photographs of the components and give first hand instructions to the field forces.

Ten Years of Experience . . . Philadelphia Electric's experience has been gained from some 200 units placed in service over a period of about ten years. The sizes are 1,000 and 1,500 kva per unit for operation on 33- and 13-kv transmission lines. The fundamental idea of enclosing the apparatus in one container and protecting it with a metal enclosure, all built in a factory rather than as piecemeal assembly, has been extremely satisfactory. The units have more than offset the undesirable features of the previous types of installation.

The economy to any one user is involved in his particular situation as regards his field labor costs, need of relocation of facilities, and the amount which can be devoted to maintain public acceptance of the service facilities. A comparison of actual installation costs between users is fair only when the more intangible conditions have been evaluated.

Looking Ahead . . . As for the future, the flexibility and economy of the unit scheme to supply quickly developing loads assures its use. The number of units needed for yearly expansion is proportioned to the load requirements.

During 1952, some 30 units will be installed. Over a 5-year period, 20 units per year is a fair estimate.



EVOLUTION OF SECONDARY adheres to No. 2 wire but meets load growth by larger transformers and closer spacing. When density of single-phase load doubles, next size of transformers is used. Units are loaded to 125% rating; voltage drop remains about 2½%

Secondary System Is Best Established Segment of Distribution

HAROLD COLE, Chief Planning Engineer, Engineering Department, Detroit Edison Co

Distribution engineers who 20 or more years ago made their decision as to the economic combinations of transformers and secondaries on the basis of a fairly rapid and continuing growth of residential loads have had their judgment amply vindicated. Several studies of the subject were made at that time. The conclusion quite generally reached was that the most economical size of conductor to install for secondary mains in residential areas was No. 2 copper. For the actual load densities then prevailing, No. 4 copper was somewhat more economical; but for the higher loads which might be expected to develop during the life of the installation, the use of the larger conductor could probably be justified.

Load densities are now generally up to the point at which No. 2 copper was found to be the most economical, and they are still increasing. A more general use of No. 0 copper does not seem as yet to be justified in residential areas, except for situations where close spacing of transformers is difficult to obtain and higher than normal load densities are expected to occur. In commercial areas the use of No. 0 copper is more likely to be justified as load densities are usually very high in these areas.

Transformer Spacings . . . Another conclusion of the earlier studies of transformer and secondary combinations was that, with No. 2 secondaries, transformer spacings of from 600 to 800 ft were preferable to longer spacings. This was in spite of the fact that shorter spans resulted in a greater initial investment because of the larger number of smaller transformers required. Increased initial cost of this arrangement was not great. And it had the advantage of being better able to give satisfactory voltage where large concentrated loads, such as electric ranges, had to be served at locations midway between transformers. Close spacing of transformers also resulted in fewer voltage dips because of the starting of appliance motors. Load densities up to 50 to 75 kva per 1,000 ft could be handled simply by replacing the transformers with larger ones in the same location.

Respace for Growth . . . Load densities have now reached the point where with No. 2 copper or equivalent aluminum conductors, spacings should not exceed about 600 ft. As residential load densities increase further, it will be necessary to respace many of the transformers on existing secondaries in order to reduce voltage drop. If this is done, however, very much heavier loads can be satisfactorily carried with only a moderate reduction in transformer spacing.

For example, a reduction of spacing from 750 to 500 ft

will permit load density to be increased from 50 kva per 1,000 ft to 100 kva per 1,000 ft with the same voltage drop in the secondaries.

New Costs Do Not Upset . . . Cost of material and labor has increased greatly. This might be expected to have some effect on the choice of transformer and secondary combinations for best economy at present prices. The cost of copper wire has just about doubled since 1935. Transformer costs have increased in about that same proportion. Labor costs, when all overhead and fringe benefit costs are included, are about three times the pre-war figure. Only the cost of losses has remained fairly constant through the years.

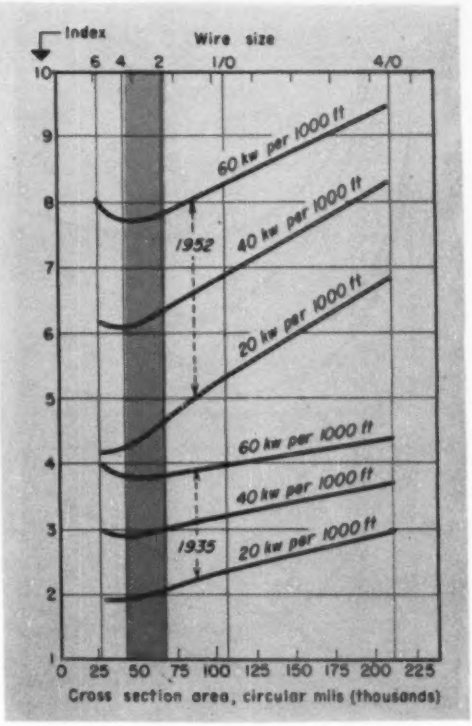
If Kelvin's Law could be applied to determine the economic size of secondary wire this would favor the use of a smaller size of conductor, but other factors predominate in this case, the most important of which is the secondary voltage drop. In order to keep the service voltage within a narrow enough range to give satisfactory operation of lamps and appliances, it is necessary to limit the voltage drop in secondary mains to 2½ to 3%. This is much less than the most economical voltage drop would be if this limitation were not imposed. The cost of losses, therefore, is a relatively minor factor. More than ever the size and spacing of transformers and the size of secondary wire to give the lowest investment cost are the determining factors.

No. 2 Still Indicated . . . Curves on the chart give relative 1935 and 1952 cost of transformer and secondary combinations for several load densities. A limiting voltage drop of 2½% was used to determine transformer spacing.

For load densities of the order of 60-kva per 1,000 ft, now quite prevalent, the 1935 curves show No. 2 copper to be at least as economical as No. 4. The two sizes are still nearly equal for the higher load densities at 1952 prices. The greatly increased labor costs, however, would favor using larger wire sizes and closer spacing of transformers where high load densities are fairly sure to develop soon as the cost of replacing secondaries or respacing transformers is much higher. The substitution of aluminum for copper for the secondary conductors will also favor the use of larger conductors because of the somewhat lower cost of material.

Present Secondaries Right . . . It would seem, therefore, that there is no good reason for making any great change in present practices with regard to secondary distribution. The secondary system from the distribution transformer to and including the customer's meter is the most stable part of the entire electrical distribution system. Very little added investment has been required in this part of the system to enable it to carry loads of two or three times those which were prevalent in built-up areas at the time it was installed. It has only been necessary so far to increase the size of the distribution transformers. Further increases of like amount can still be handled satisfactorily without any major change in this secondary system. This fact has done much to make it possible to keep down the overall investment in the distribution system and counteract the effect of the increased cost of new additions to the system.

The one development which seems most likely to bring about a major change in the secondary system and its associated transformers is the increasing demand for three-phase service in residential areas to permit the use of three-phase motors.



RELATIVE COSTS of secondary (per 1,000 ft) for transformer and secondary wire installed plus capitalized losses have doubled since 1935. No. 2 stays advantageous despite tripling of load and has same promise into the future of electric distribution system

This will raise the question as to whether the three-phase, 4-wire, Y-connected system now used for underground network secondaries should not be used for overhead secondary mains in residential areas. However, the use of 208 v, not only as a service voltage for three-phase motors but for single-phase appliances designed for 230 v, would make this change difficult to accomplish. The incentives are not so great as they were in the case of the underground networks.

A more practical solution to the problem of providing three-phase service without the introduction of substandard voltages may well be to utilize a 4-wire delta system.

House Heating . . . In some parts of the country the use of electrical energy for house heating is creating tremendously increased demands. Transformer capacities have to be greatly increased. But it will usually be possible to continue to use No. 2 copper or equivalent economically if transformers can be added so as to reduce the spacing uniformly. The heaviest demands will occur in very cold weather when the transformers can best carry heavy overloads without much danger of overheating.

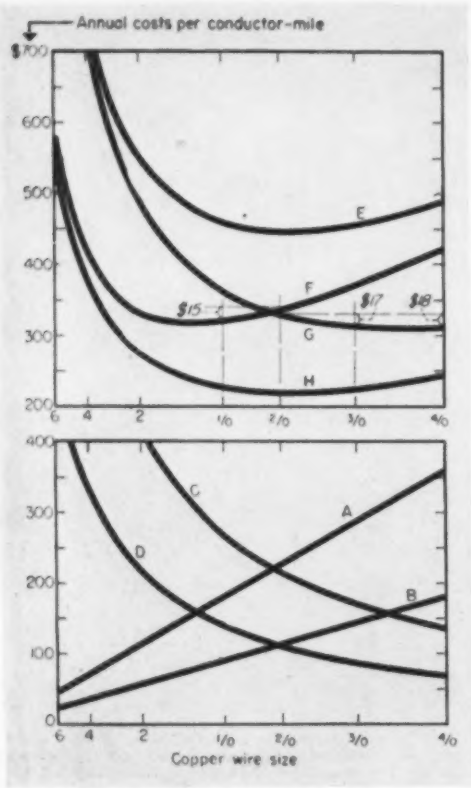


FIG 1—ANNUAL FIXED CHARGES on that part of investment varying directly with conductor size are taken as 14%, in Curve A on 60-cent copper and in Curve B on 30-cent. Note that similar 2/1 ratio would result if fixed charges were, say, either 7 or 14% on 60-cent copper. Copper losses are taken (Curve C at $50 per kw-yr demand and Curve D at $25) for 100-ampere loading at time of system peak. Curves E to H give total annual costs, with C + A represented by Curve E, D + A by Curve F, C + B by Curve G, and D + B by Curve H

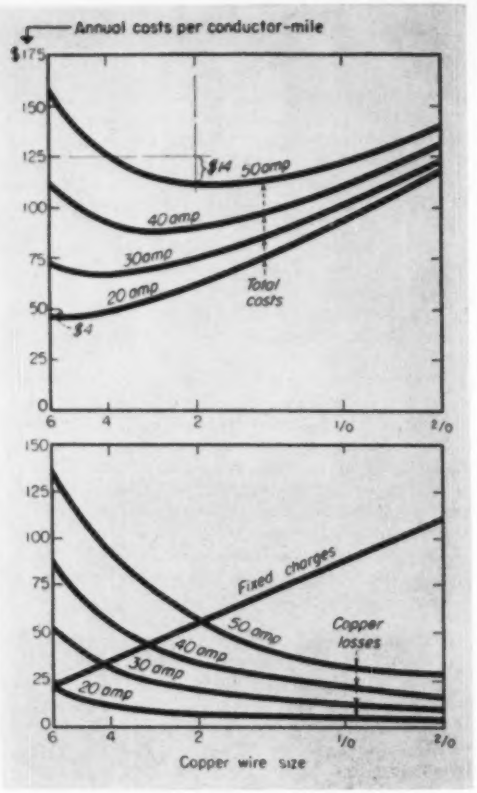


FIG 2—EFFECT OF OTHER LOADING than 100-amperes assumed in Fig 1. Fixed charges are as in Curve B of Fig 1. Sizeable error in assuming ampere loading doesn't seriously affect total annual cost

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Choice of Right Wire Size Simplified by Charts and Tables

Guides recognize variation in cost per pound and fixed charges and the importance of including evaluated losses. Slight errors in assumptions fortunately result in even lesser cost departures

Niagara Mohawk's Standards Committee prepared (initially in 1943) a table of "maximum amperes" for distribution conductors. It permitted much greater loads than had previously been used as maximums, particularly for the smaller sizes of conductors. By 1945 it was apparent that this table was influencing design toward heavier initial loadings.

Further study indicated that it was practicable to issue a table which could be used with judgment to put a consideration of losses into the solution. However, it is by no means fixed or arbitrary. It is felt that the conductor sizes represent values near the bottom of Kelvin's Law curves.

* Adapted from author's paper entitled "Economic Conductor Sizes for Overhead Distribution Systems" presented at AIEE symposium in Binghamton, April 30, 1952.

An error of two to one in the basic assumptions indicated in Fig 1 would result in a selection of wire size which would add only 5% or 6% per year to the annual cost of the conductors. The effect on total annual cost of the line is much less than 5%.

An Extreme Case as an Example . . . Taking an extreme case, assume Curve F is correct but select the wire size from G or vice versa. Added costs (difference in ordinates) will be about $60 in the first case or $100 in the second. This certainly is not good, but it represents an increase of only about 30% in costs for errors in assumption that vary two to one for value of copper loss and two to one for fixed charges on copper costs.

Note that if losses are not considered, a No. 6 conductor could be selected (Curve B or A). The annual costs which include losses would be from $300 to $700 more, or about three times as much as if some reasonably economic wire size had been selected.

A similar condition is encountered if the load is more or less than estimated. Consider the curves in Fig 2 and assume that the costs shown are correct. Load is estimated at 30 amp, but the difficulty is to estimate future loads. On the basis of the estimated load, No. 4 wire would be selected. If the load increased to as much as 50 amp, a No. 2 conductor would have been more economical but the use of No. 4 will have added only about $14 or 13% to the annual costs.

If on the other hand the load were only 20 amp, a No. 6 conductor would have been more economical; but the use of No. 4 would have added about $4 per year to the cost.

Line Losses Affect Economy . . . Serious differences of opinion on some of the basic assumptions thus do not necessarily result in serious difference of opinion on the economical wire size. However, a conclusion that losses in distribution lines are intangible or not worth considering will lead to thousands of small decisions which may seriously affect economy.

When loads exceed twice the recommended values, the losses begin to be appreciable. It may be economical for this and other reasons to consider an increase in copper or a decrease in the ampere loading.

Economical Wire Size For New Installations Of Overhead Distribution Conductors

Amps at Sending End		Conductor Size	
Concentrated Load at End	Distributed Load	Residential	Industrial
10	15	6	6
20	30	6	4
30	50	4	4
40	65	4	2
50	85	2	2/0
60	100	2	2/0
70	120	2	2/0
80	135	2/0	2/0
90	155	2/0	4/0
100	170	2/0	4/0
125	215	4/0	4/0
150	260	4/0	350
175	315	4/0	350
200	345	4/0	350
250	435	350	500
300	520	350	500
350		500	500
400			

How To Use The Table

1. Determine if load is concentrated at end of section or is uniformly distributed along the section. If part of load is carried to the end and part is distributed, use judgment in selecting values.

2. Determine if load is residential or industrial. Load should be considered industrial if load factor is high, 80-100%, residential if load factor is low—below 40%. For intermediate values use judgment.

3. Estimate the ampere loading which can be reasonably expected to occur at the time of system peak during the next few years.

4. Determine economic wire size from table, using the above values with necessary judgment.

5. Check general costs of poles, towers, fixtures, etc. using recommended wire size and one size smaller or larger conductor.

6. Check size of conductor needed for voltage regulation, emergency future load, fuse coordination, etc.

If price of conductors is the only controlling factor, use the recommended size.

If cost of base plant (poles, towers, fixtures, etc) is increased by large conductor, a conductor one size smaller may be used. This applies particularly to lines where larger size conductors require shorter spans.

If voltage regulation, emergency operation, etc, govern, check costs with and without voltage regulators, capacitors, etc. Large conductors without supplemental regulators or capacitors should be favored unless total initial costs are appreciably lower.

In general, never use a conductor for permanent installations two sizes smaller than recommended. Do not use conductors two sizes larger than recommended without careful consideration of value received.

As long as growth continues, errors in the direction of large conductors will generally be less expensive than those that favor small conductors. We expect increased demands for improved service. Here again it is usually less expensive to err on the side of large conductors.

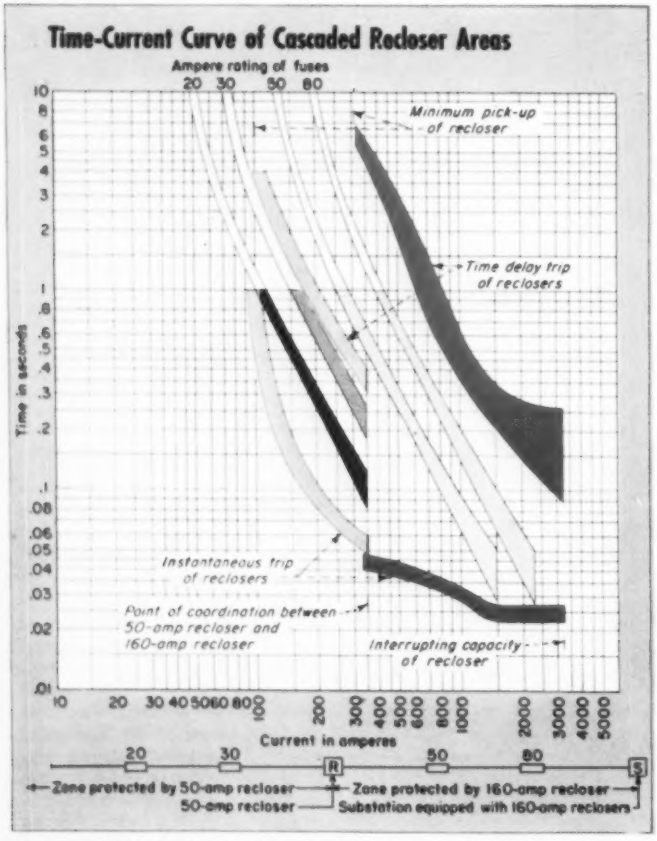
Trial solutions based on today's prices indicate a slight shift in the direction of heavier loading of copper conductors. Use of bare aluminum conductors appears to bring the fixed charges below those for "equivalent" copper. It may then be economical to decrease the recommended current values or to use aluminum conductors somewhat larger than "equivalent" copper. Pending availability of more detail knowledge of depreciation, maintenance, and operation of aluminum conductors, it is proposed to use the table for aluminum conductors on an "equivalent" copper basis.

Reclosers Reduce Distribution Interruptions to Practicable Minimum

Performance of 800 so successful that 200 more are planned for 1952. Substations doubled with slight increase in distribution service force. Investment saving over $750,000 vs oil circuit breakers.

J. S. **FRANCIS**, Senior Engineer, and **A. LAMEIKA**, Associate Engineer
General Engineering Dept, Consumers Power Co, Jackson, Mich.

Consumers Power Co has used reclosers since 1946 when a program was instituted to relieve overloaded equipment and excessive voltage drops on long feeders. Substations of 750 and 1500-kva capacities were constructed at rural load centers instead of increasing the size of substation equipment. These new substations, designed to operate at 4.8/8.32-kv multigrounded, incorporated the newly developed 100-amp reclosers for improved continuity of service.


Time-Current Curve of Cascaded Recloser Areas
Ampere rating of fuses
20 30 50 80
Minimum pick-up of recloser
Time delay trip of reclosers
Instantaneous trip of reclosers
Point of coordination between 50-amp recloser and 160-amp recloser
Interrupting capacity of recloser
Time in seconds
Current in amperes
20 30 R 50 80 S
Zone protected by 50-amp recloser
50-amp recloser
Zone protected by 160-amp recloser
Substation equipped with 160-amp reclosers

SECTIONALIZING FUSES and reclosers provide coordination as indicated by time-current curves in two cascaded recloser areas. Recloser operation has exceeded expectations

Tests of the first reclosers purchased were satisfactory although some were erratic on the time-delayed operation. The most desirable time-current envelope was soon found, and this was used by the manufacturer in designing a reliable mechanism. Now each unit is adjusted to this operating envelope before shipment from the factory. The initial 100-amp recloser installations proved successful beyond expectations. So highly did the operating personnel regard them that, within the first year, a change to reclosers was made on all substations where they could be applied.

From Rural to Urban . . . From the original recloser application in rural type substations, its use spread through substations for resort areas, to smaller communities, and now is firmly entrenched in substations serving areas within the ampere size limits of available reclosers and their interrupting capacities. When a 160-amp size recloser became available, it was adopted and utilized on urban circuits up to 1,250-kva. As larger sizes of reclosers are developed, they will be used in all but the largest urban or industrial substations, where frequent switching and additional control requirements point up the use of oil circuit breakers.

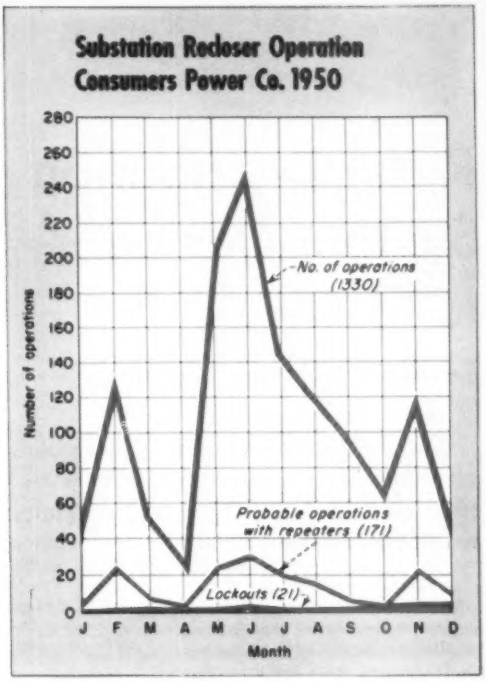
Small Pickup . . . In the average small substation area the recloser provides reclosing protection against temporary faults to all but the most remote tag ends. In the case of a 2,500-kva substation and the larger size reclosers, a smaller area receives reclosing protection from the substation reclosers. Hence, it is necessary to apply 50-amp reclosers for the remaining area at points where the available short circuit current approaches the minimum pickup of the station recloser. Figure 1 shows time-current curves for the

Table I—698 Reclosers in Service as of Dec. 31, 1951

Substation Installed Capacity	Rated Size of Reclosers						
	100 Amp			160 Amp			
	Operating Voltages						
Kva	4.8-kv Delta 4.8-8.3-kv Wye	7.2-12.5-kv Wye	11-kv Delta to 14.4-kv Delta	2.4-4.16-kv Wye	4.8-8.3-kv Wye	7.2-12.5-kv Wye	11-kv Delta to 14.4-kv Delta
750-1000	95	—	3	6	—	—	—
1500	462	12	—	—	—	12	—
2000-2500	—	6	6	—	57	6	12
4000-5000	—	—	—	—	12	9	—
Totals	557	18	9	6	69	27	12

Table II—Maximum Permissible Substation Load in Kva Using Recloser Protected Circuits

Operating Voltage	Reclosure size in amperes				
	100		160		200
	Number of recloser circuits in substation				
	1	2	1	2	2
2,400 Delta	320	550	520	870	1,100
4,160 Wye	560	950	900	1,500	1,910
4,800 Delta	620	1,080	1,000	1,730	2,100
8,320 Wye	1,100	1,870	1,800	3,000	3,750
7,200 Delta	970	1,620	1,550	2,600	3,250
12,500 Wye	1,650	2,800	2,700	4,500	5,600
11,000 Delta	1,400	2,400	2,350	3,850	
14,400 Delta	1,850	3,100	3,000	5,000	



OPERATING RECORD of 417 substation reclosers show 1,330 operations, of which 21 were lockouts. A sleet storm in February and tree contacts because of wind during May-July account for highs

two cascaded recloser areas showing the operating ranges of the sectionalizing fuses used with each recloser.

200 More in 1952 . . . In addition to the tabulated substation reclosers (Table I), another 114 reclosers, mostly of the 50-amp size, are presently installed on distribution circuits. Construction plans for 1952 call for adding over 150 new substation reclosers and approximately 50 reclosers on distribution circuits.

Selection of recloser size for a given substation is determined by the maximum kva of load on a distribution circuit which can be picked up by the recloser after a prolonged outage. Where a substation has two circuits, the total kva load on the substation is less than twice the single circuit value to allow for unequal loading of the circuits (Table II).

Manpower Stabilized . . . Reclosers have held down the manpower needed to operate the increasing number of substations. The few service calls received from these areas usually involve either pole or wire failures or faulted transformers. Substation calls have been practically reduced to the monthly inspection trips for general condition of the station.

Storm Inspection Obviated . . . To indicate the probable performance that might have been obtained had repeater fuse switches been used, a curve was plotted on the basis that an interruption would have occurred when three or more operations were recorded by the recloser between inspection trips to the substation. Under these assumptions, a total of 171 interruptions might have been experienced or over eight times as many as actually occurred. With repeater fuses, it had been the general practice to inspect each substation as soon as possible after a storm to be sure that all three fuses were available for use. Because of frequent storms, this meant more than one trip to a substation in a very short period. Now, unless trouble is reported, stations equipped with reclosers are seldom inspected immediately after a storm, and in many cases not until the regularly scheduled inspection.

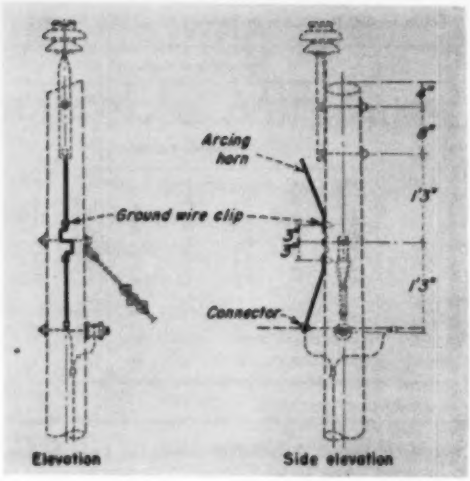
Very few reclosers have failed—one because of a burned out operating coil and several because of relay contact trouble. None has failed because of excessive short circuit current, and experience indicates the manufacturer's short circuit ratings are conservative. A few reclosers were found to be defective before being placed in service because the contact-follower fiber rod had been swollen by moisture. This was the result of improper storage.

Inspection Schedule . . . Consumers Power Co's present program of preventive maintenance consists of internal inspection and calibration every two years or 100 operations whichever comes first. The units are brought into the shops where they are untanked, cleaned, inspected, and electrically calibrated. Any defective part or parts in questionable condition are replaced. Calibration tests have indicated that the majority of reclosers tested do not require any adjustment.

Rural Distribution System Design Is Elastic

To Meet Higher Loadings

Basic system accommodates growing loads by higher voltage, added phases, more frequent substations. Quality of service dictates the progressive evolution



VERTICAL CONSTRUCTION is standard practice on REA-financed single-phase lines. Arcing horns are bent to establish the desired gap and minimize radio interference from the 14.4-kv circuit

WADE M. EDMUNDS, Assistant Chief, Engineering Division, Rural Electrification Administration

Cost and adequacy of distribution systems in rural areas have been of paramount concern to the Engineering Division of the Rural Electrification Administration since the first lines were designed in 1936 at a primary voltage of 7.2/12.5 kv. To the extent possible it has been the policy to provide sufficient capacity in the distribution system and avoid the costly overhead of transmission.

It became apparent within 2 or 3 years that the estimated loads used in the early system studies were too low and revised system studies are being made in nearly all cases. It was during this period that serious consideration was given to the use of a distribution voltage above 7.2/12.5 kv to meet the coming demands. The fundamental trends in rural distribution design are higher voltage, improved service and more standardization.

Higher Voltages . . . Length of lines in rural areas is of much greater consideration than in urban areas. The national average REA-financed distribution system has approximately 1,200 miles of line and a density of 3.1 consumers per mile. Radial lines vary from about 20 to 50 miles in length.

The REA-approved designs of a distribution system are based on the estimated power requirements per consumer for the overall system for a future period of 10 years. However, it cannot be assumed that the capacity of such a system will be adequate for the periods beyond 10 years. Therefore, provision must be made in the basic design for increasing the capacity by adding facilities rather than rebuilding. This means that a foundation must be laid upon which a distribution system will grow with load by means of the most economical changes.

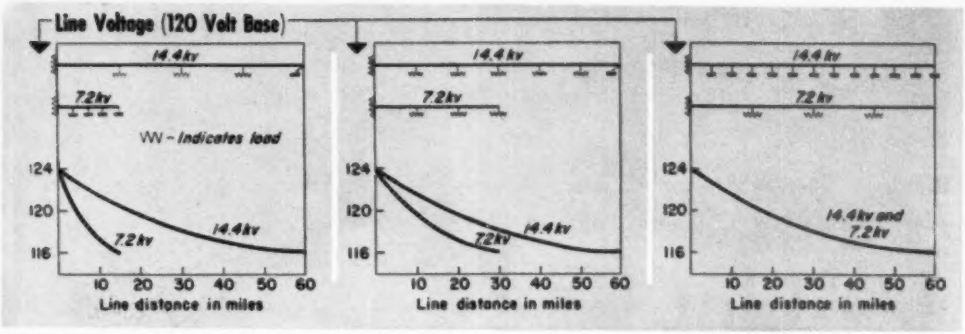
Single-Phase Declining . . . Single-phase, multigrounded circuits still predominate in rural areas but to a lesser extent than 10 years ago when loads were smaller. The addition of one phase conductor to that circuit doubles the capacity and adding still another increases the circuit capacity 4 times. The ratio of increased capacity from single phase to three phase from the regulation standpoint is then 1:2:4 for multigrounded circuits on which the conductor size remains the same.

The foregoing sequence offers a simple and economical progression in obtaining increased capacity in circuits, but other facilities, such as substations, must be added at times. Heretofore, it has been considered fundamental that as a system grows in load density, area, or both, a given voltage becomes outgrown so that transmission lines, with substations, are added, thereby breaking the area up into smaller units in order to use the same distribution voltage. This concept has its economic limit. When that limit is reached, a higher distribution voltage must be considered.

Loads Ascending . . . A 7.2/12.5-kv system appeared to be adequate for the loads and distances forecast until recent years. However, the kwhr per consumer has been steadily increasing until now consumptions of 300 and 400 kwhr/month per consumer are not unusual, and distances from power sources in some areas are as much as 70 miles. Load growth has been met by increasing the number of phases, increasing the size of conductors, and providing additional sources of supply.

By 1947, increasing loads, greater distances from power sources, and decreasing density of farms brought a realization that the prevailing pattern would not meet future requirements. Many cost estimates indicate the feasibility of 14.4/24.9-kv distribution systems.

Adoption of 25 kv . . . The decision was made to build some systems at the higher voltage even though it involved a calculated risk in using available 13.8-kv transformers designed for delta circuits of that voltage. While the performance of 15-kv



LOAD CARRYING ABILITY of a 14.4-kv line: (a) it will have same maximum voltage drop as a 7.2-kv line at four times the distance to the same load and over the same wires; (b) it will carry twice the load to twice the distance; (c) it will have four times the capacity

class transformers and arresters continues to be satisfactory after three years use, there is a question of shortened life because of possible overstressing of the insulation. However, since the first system were designed, an almost complete line of equipment has been developed by manufacturers for use on the 14.4/24.9 kv systems conforming to the following general requirements:

Pin insulation—Radio freed, nominal 23-kv, 95-kv dry flashover, 65-kv wet flashover.

Transformers—18-kv class, demonstrated impulse withstand strength 125-kv full wave, 145-kv chopped wave, chopped at 2.5 micro-seconds.

Reclosers—Nominal 23-kv, demonstrated impulse withstand 150-kv full wave, maximum interrupting rating not less than 750 amp rms.

Lightning arresters—15-kv and 18-kv ratings acceptable, if not guaranteed.

Sectionalizing fuses—18-kv rating.

Substation equipment—25-kv class.

In addition, all equipment must satisfy a very rigid radio noise test before acceptance for use on these systems.

Cost Pared 70%—Overall cost, including transformers, of a new 14.4/24.9 system is about 20% higher than a new equivalent 7.2/12.5-kv system, assuming the same size conductor and phasing. On the other hand, as the line capacity is quadrupled, the construction cost per kw of capacity of the 14.4/24.9-kv system is approximately 30% of the 7.2/12.5 system of the same conductor and phasing. At the higher voltage fewer miles of multiphase lines are needed thereby reducing the cost of a distribution system.

Within the past four years 37 REA borrower systems with a total of 10,988 miles of multiphase and single phase 14.4/24.9-kv distribution line have been energized and are now in operation. At the present time 32 systems have 9,695 miles of 14.4/24.9-kv distribution line under construction, and 39 are planning on adding 10,091 miles of such distribution line to their system.

Conversion Studied . . . Conversion of some existing systems to the higher voltage must be given serious consideration at this time because of the increasing size of future loads. The conventional idea of adding transmission and substations to a system does not always answer the problem for that period beyond 5 or 10 years.

In determining whether a 7.2/12.5-kv distribution system should be converted to 14.4/24.9 kv, the following studies are made:

1. Cost estimate of conversion, utilizing autotransformers for 7.2-kv extensions where feasible.

2. Cost estimate using 7.2/12.5 kv plus additional transmission and substations.

3. Cost estimate of converting to 14.4/24.9 kv and extending such lines into new territory.

4. Continuity of service.

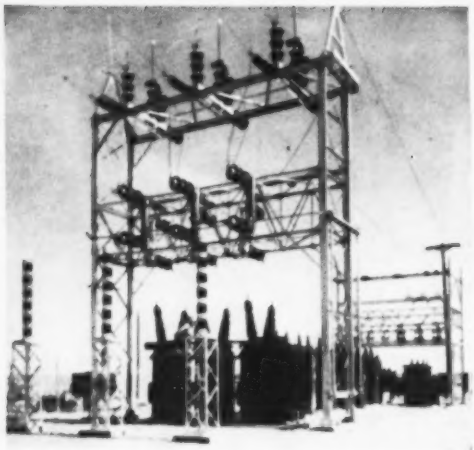
5. Comparison and evaluation of losses in the system for the two voltages.

Improved Quality of Service . . . Continuity of service is of prime importance in rural as well as in urban areas. Although higher voltage systems have comparatively long circuits which serve large areas, low-cost, pole-mounted, oil-circuit reclosers properly coordinated among themselves or in combination with fuses or sectionalizers provide the means of obtaining the degree of reliable service needed.

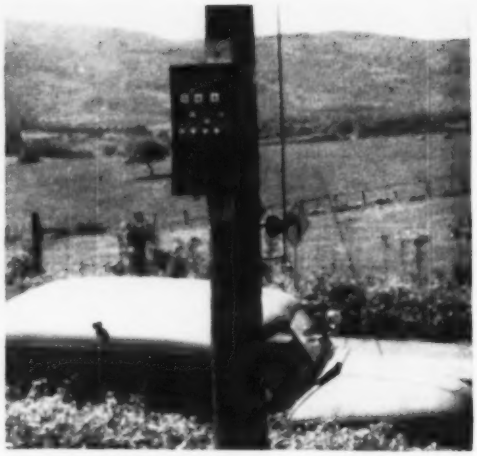
As an aid to rapid reporting of outages, an Outage Monitor has been developed and installed experimentally. The monitor consists essentially of transmitter, receiver, indicator, and remote modulators. See AIEE Technical Paper 51-237, "Application of Power Line Outage Monitor," Section T1-237, AIEE Transactions, Volume 70, 1951.

Regulators at Substations . . . Base voltage at substation is established at 120, and regulators are installed on the load side of the substation transformers to maintain an output voltage during peak load between 124 and 127 v and during light load between 120 and 124 v.

Calculation of voltage drop is made on the basis of the estimated system, ie, the maximum kwhr per consumer per month related to the basic 10-year estimate within the established geographical area. The maximum permissible voltage drop in the primary line is 7%, and the voltage drop from the primary connection of the transformer to the consumer's meter should not exceed 5%. This drop, of course, includes that in the secondary and service conductors. Voltage-drop calculations are prepared prior to the construction of each project. Design is based on the percent voltage drop



STRAIN BUS is standard construction practice employed on the 115 kv to 7.2/12.5 kv substations of REA financed distribution systems



OUTAGE MONITOR TRANSMITTERS automatically report interruptions on rural lines to dispatching office for prompt attention

along the distribution line and with the power supply held between the limits mentioned above.

Primary Drop Limited . . . Maximum primary voltage drop of 7% was established by REA in October, 1950 in order to provide design limits of 110 v minimum and 127 v maximum at the consumer's meter. The minimum design voltage will be supplied only to a consumer at the end of a maximum loaded line when that consumer uses maximum load. This condition would rarely exist. The maximum design voltage will be supplied only to a consumer at or near the substation when he uses minimum load during the peak period. Consumers located between the substation and the midpoint of the line may expect a voltage from 117 to 125. Consumers located between the mid-point and the end of the line should have a voltage between 110 and 117.

Use of line type regulators is considered a temporary expedient to maintain a satisfactory voltage until the load justifies multiphasing. In rare cases regulators are installed on long, lightly-loaded, single-phase lines where multiphasing might not be feasible. The step-type regulator with boost and buck is most commonly used, having 5/8% steps. However, a single-step regulator has been developed which is both economical and apparently satisfactory for correcting excessive voltage drop on long rural lines. A voltage sensitive control is used to actuate a mechanism which in turn switches a series winding for 4.5-v boost or neutral connection; such a fluctuation may occur a maximum of 5 times per hour without causing objectionable flicker. See AIEE Miscellaneous Paper 51-39, "Single Step Voltage Regulator Application."

Capacitors . . . The growth of motor and other inductive loads for farm uses is being accompanied by a downward trend in system power factors resulting in the application of power factor penalty clauses in the purchase of wholesale power as well as causing increased system losses and voltage drop problems. Shunt capacitors have been in common use for many years to correct power factor. Therein lies their greatest benefit to rural power systems, followed by reduced line losses, released substation capacity, and improved system voltage. Series capacitors are useful in special applications, but low cost protective equipment is not yet commercially available.

Materials and Equipment . . . REA has always approved the use of ACSR as well as copper type conductors for primaries. Since December 1946 covered aluminum for secondaries and services has been acceptable. Since 1949 the use of ACSR has increased substantially over previous years, due primarily to more of that type conductor becoming available and the difference in cost. The following table indicates the approximate relative use of ACSR and copper types of conductor:

Miles of Line Constructed

	ACSR	Copper Types
1949	37%	63%
1950	60%	40%
1951	69%	31%

Standardization . . . Standardized substation structures have been adopted recently with a saving in engineering time and in material and labor costs. Station arrangements are generally similar for rural location so that the structures may be standardized for most installations. Structural members may be of galvanized steel or of aluminum alloy and designed for 1500 lb unbalanced tension per conductor. Shielding of substations is accomplished by shield wires and bayonets.

Multiple-grounded circuits with common neutral tend to simplify installations such as the use of single bushing transformers (cover type) with the accompanying conserving of hardware, cutouts, and lightning arresters. Effective use is made of reduced size neutral with the resulting saving in metal.

Conclusion . . . The design of rural distribution systems has developed rapidly in order to keep up with the continually revised load estimates and the requirements of adequate service. What has been developed so far has been done during a period of only 17 years. The present pattern should serve for another ten years, but only continuing study will provide the needed future capacity and service.

Capacitor Switching Benefits Whole System Investment

Capability for reducing loadings and improving delivered voltage has been firmly established for continued gains in distribution outlay. Visible alternatives are much more expensive

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Pennsylvania Power & Light Co

The shunt capacitor has long been accepted as the economical answer to the supply of kilovars. Within recent years the switched capacitor has become established as a device for voltage regulation also. In both jobs its benefits extend far beyond distribution alone. Since it can do two jobs for less than the price of one of the former, it is inevitable that the switched capacitor is destined to play a vital role in the future planning of the power systems for "economic workability."

Job of any power supply system is to carry the load and deliver adequate voltages. This simple fact has led to methods of reducing loading through power factor improvement and of regulating voltage to the extent necessary. Quite satisfactory ways of doing each have been used for a long time.

Synchronous condensers at load centers have both reduced loading and improved voltage conditions between the generators and the load centers. Feeder and bus voltage regulators (including transformer tap changers under load) have done an admirable job beyond the synchronous condensers. These things have been good, but the capacitor now affords a better and more economical way.

Load Capacity Released . . . Obviously the number one job of capacitors is to supply the kilovars required by the kilowatt load and kilowatt transportation. Local supply of reactive reduces system loading and losses for the same load. Or, what may be more important, it permits carrying greater loads on the same facilities.

The trouble with trying to reach this goal with capacitors alone is that enough capacitors to reach 100% power factor during heavy load conditions will result in intolerably low leading power factor during light loads. Extensive use of capacitors demands that all excess amounts of capacitance must be removed during light load conditions.

Switched Capacitors . . . Switching capacitance must be removed during control. Connecting a capacitor to the system to supply kilovars raises the voltage; but unless it is later disconnected, it leaves the voltage raised. If, when a load comes on, however, enough capacitors are switched on to overcome the voltage drop due to load, there is no change in voltage. Thus flat or near flat voltage regulation at the load requires only that the right amount of capacitance be switched on and off with the load.

Actually, part of this job can be done by raising generator voltage during heavy load periods; and another part of the job is not even needed because flat regulation is not required. Adequate voltage regulation can thus be accomplished on the average system by practical amounts of capacitors when applied for voltage control.

Capacitors Switched . . . Pennsylvania Power & Light (schematic in Fig 1) is comprised of 66-kv transmission and 12-kv and 4-kv distribution systems. Load is served directly from all three voltages. Generator voltage is raised and lowered with the load to compensate partially for drops in the lines and transformers.

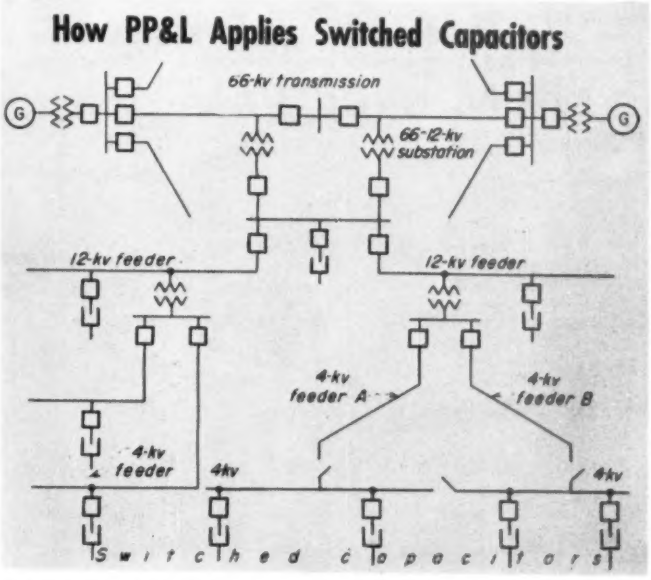

FIG 1—SWITCHED CAPACITORS are applied to 4-kv and 12-kv feeders and to some 12-kv buses of the PP&L system. Switched capacitors play an important part in control of voltage

FIG 2—POLE TOP, 180 kva, 4 kv switched capacitors under 4 kv feeder. Control box on side of pole is fed from 120/240 v secondary

FIG 3—ONE 450 kva unit of 12 kv, three-phase installation is on each of three poles. Control power is supplied from center pole

Switched capacitors are applied:

1. In banks of 180 kva and up toward the ends of the 4-kv feeders to supply 4-kv reactive load and to regulate voltage to the greatest extent feasible.

2. In larger banks of 450 kva and up toward the ends of the 12-kv feeders to supply 12-kv reactive and regulate voltage on the 12-kv feeder and beyond.

3. On 12-kv buses of 66-12-kv step-down substations to supply 66-kv reactive load and regulate voltage as far out from the generators as feasible.

The sizes of the latter capacitors vary from 600 to 6,000 kva, depending on the size of the substation and the need for reactive supply. Typical installations of all three are shown in Figs 2, 3, and 4.

Tap Installations . . . For single-phase, 12-kv and 4-kv taps, installations are similar to the types illustrated, except that sizes are about one-third and only one phase of the 12-kv job is installed.

In locating capacitors one aim should be to keep the "center of gravity" of the capacitors a little farther from the generators than the center of gravity of the load. This increases the effectiveness of voltage regulation and endues switched capacitors with ability to do an adequate job without the help of feeder regulators.

Alternatives . . . Switched capacitors thus attain the two major objectives of maximum load carrying capability and adequate voltage regulators with one and the same device. It is profitable to examine an alternative procedure.

The basic principle of the switched capacitor is not new. For many years, both load reduction and voltage regulation to a lesser degree have been obtained with synchronous condensers located at load centers. But capacitors can be economically applied so much more extensively.

Synchronous condensers are prohibitively expensive except in the large sizes. They can be applied only at load centers, usually on the subtransmission system. But in this location, they do nothing for either load reduction or voltage regulation in the distribution system beyond the load center.

For kvar reduction a great deal has been done by rewarding power users for good power factor. And for voltage regulation, there have long been the feeder voltage regulator and its successors the bus voltage regulator and transformer tap changers under load.

Feeder Regulator Alternative . . . Switched capacitors, applied in the manner illustrated in Fig 1, actually cost less than feeder regulators above.

Assume that the total load on the part of the system covered by Fig 1 is 20,000 kw at 80% power factor and that the load is divided 5,000 kw on 66 kv, 10,000 kw on 12 kv, and 5,000 kw on 4 kv. The 15,000 kva of

FIG 4—RACK TYPE INSTALLATION on 12 kv bus is used to supply reactive load and regulate voltage as far out from generators as feasible. Units vary in size from 600 to 6,000 kva

switched capacitors needed to correct on-peak power factor to unity would cost roughly $150,000.

Bus Regulation . . . The installed cost of bus and feeder regulators needed for 10% boost or buck and allowing 20% marginal capacity for the 12-kv and 4-kv loads would be about $300,000. And the value of the estimated saving in losses and the released line and transformer capacity would be at least another $200,000.

Reduced Investment . . . Switched capacitors not only take the place of both the synchronous condenser and the feeder voltage regulator but actually cost less than either. Switched capacitors provide other economies.

In range of effectiveness the switched capacitor has an outstanding advantage over the synchronous condenser. Since condensers are economically feasible only in large sizes, their usefulness extends only as far from the generators as the load centers. On the other hand, with the steady reduction in the cost of capacitors and capacitor switches that has been made in recent years, it is now quite economical to install switched capacitors in small blocks away out on the ends of the distribution feeders or wherever else they may be required. Each block of capacitors has its effect on the loading and power factor all the way from the generator to the load. Line and transformer loading from the generator to the load has been reduced. An improvement in voltage has also been made all the way out to the load.

Idle Marginal Capacity . . . Investment in capacity to take care of load growth may lie idle until the growth materializes. Here again the switched capacitor shines. Whereas the feeder voltage regulator, which like the transformer should be large enough to take care of the load growth for a while, does require marginal capacity on the average, the switched capacitor can be added in small "bites" as required. Add load and then add capacitors. The cost per kva of capacitor is fairly independent of the amount added. That's all there is to switched capacitors.

Duplicated Facilities . . . Still another way of keeping down investment cost is to avoid duplication of capacity wherever possible. With switched capacitors, the capacitor is part of the load; and when the load is switched, the capacitor goes with it. Thus one block of load requires only one block of capacitors. Stated so simply, the importance of this may easily be overlooked. The diagram (Fig 1) will help to emphasize this importance.

If it becomes necessary to supply the end of 4-kv Feeder A over Feeder B by closing and opening the appropriate switches, both the load and the capacitor are transferred as a unit.

One more way to reduce investment is to reduce the need for reserve capacity. With switched capacitors this need decreases almost to the vanishing point because:

1. The bulk of the capacity is in small blocks.

2. The failure of a few capacitor units requires only a few minor repairs that can be made quickly.

Transformer Reactance . . . The transformer reactance deserves mention. In the past, it was quite in order to spend additional money to obtain low reactance in power transformers. Under the principle of using switched capacitors for voltage regulation, however, with on-peak power factors near unity, it is an advantage to have higher transformer reactance. While this is one of the relatively minor direct savings, it is significant of the many ways in which the switched capacitor is contributing to greater overall system economy.

Pole-Top Skimping May Save Money But Cost Accidents

Long-term overall economy in distribution circuits dictates ample space for climbing, working, and clearances. Otherwise expensive accidents will devour assumed savings

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Distribution engineers can and have contributed to accidents including fatalities. The designer cannot shrug his shoulders and blame all accidents on field supervision and human errors. In proof of this consider the causes of accidents which may be analyzed functionally as follows:

1. **Unsafe design**—The function of the designer.

2. **Human errors and carelessness**—The function of the individual.

3. **Unsafe or inadequate procedures and tools**—The function of supervision.

While most accidents involve all three of the above functions, usually one predominates.

Fatalities in the electric light and power industry compiled by the Accident Prevention Committee of the Edison Electric Institute (1944 to 1949, inclusive) involving parts of the body, other than the hands and arms are 34% of the total. Hands and arms account for 40 and 26% of the fatalities respectively. This suggests either unsafe design or poor construction in the field.

A few dollars for longer crossarms, for better equipment, for junction boxes with more adequate clearances, for roomier manholes may represent several hundred thousand dollars in the transmission and distribution system investment of millions. Compare

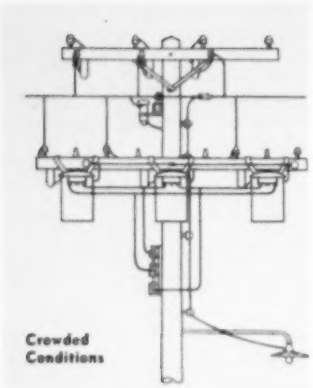


FIG 1—FOUR FUNCTIONS on one pole make congestion inevitable. Remedy lies in use of four poles in proximity to separate functions and use of 3-phase transformer

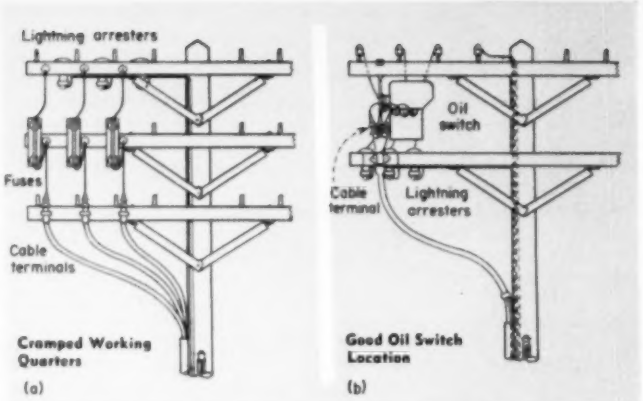


FIG 2—TO REACH the fuses (a) a lineman must climb above the cable terminals and reach across primaries. Opening such devices inadvertently under load can entail serious consequences under such conditions. Oil switch (b) would avert the hazard because its handle can be reached from the pole by lineman, with minimum exposure to energized lines

this with the high cost of accidents. Moreover, most of the items of design that make for safety also result in improved efficiency, fewer service outages, and quicker restoration of service to the consumer.

Safety Features . . . Safe design in overhead construction centers around the following features:

1. A simple pole-top layout of which the components, connections, and functions are readily understood by the lineman on the pole and the foreman on the ground.

2. Equipment of safe design, adequate capacity, readily accessible and easily and safely operated.

3. Ample working space.

4. Absence of "booby traps."

5. Adequate climbing space that is readily discerned from the ground.

6. Repetitious conditions throughout the system.

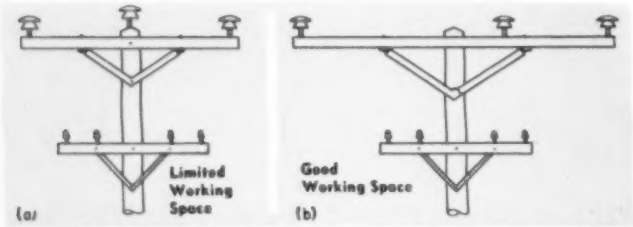


FIG 4—RIDGEPIN CONDUCTORS located (a) close above distribution crossarms limit the working space. It is better to use a long, higher-voltage crossarm (b) if head contacts are to be controlled. In addition, better clearance for setting pole replacement is provided

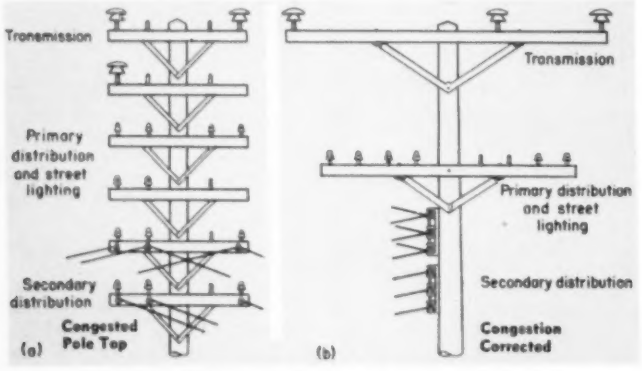


FIG 5—NUMEROUS CROSSARMS (a) restrict work areas and interfere with conductor identification. Reduction of arms (b) expands working space, enhances accessibility of conductors, and makes circuit identification easy. Cleaner appearance is another benefit

Simplicity in Design . . . Simple structures in accordance with prescribed standards permit a quick and accurate analysis of pole-top conditions by both linemen and supervisors. This aids safe work and expedites service restoration in emergencies. Simplicity in design is based on the attention given to the following principles.

1. Construction standards that establish specific locations for the various circuits and equipment carried on the pole and provide the simplest wiring consistent with the function of the pole and its appurtenances.

2. Reduced number of functions assigned to a single pole. Combining them leads to complex pole-top situations. Fig 1 illustrates simultaneous use as (1) junction, (2) sectionalizing point, and (3) apparatus support.

Safe Equipment . . . Sidewall bushing on single phase transformers provides the short leads and connection facilities desirable in pole-top equipment and combines to some extent the advantages of the pocket type and cover mounted bushings. Transformers in-

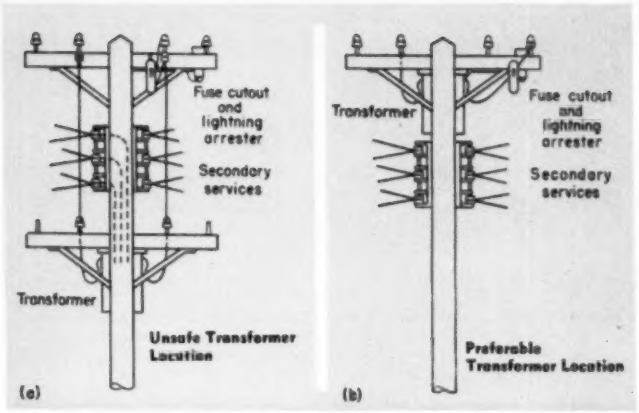


FIG 3—SECONDARY SERVICES should be below primaries and transformer. When above (a) they expose men in service work to contact with high voltage risers. Easily accessible secondary zone (b) and unrestricted working space come from putting transformer on line arm. By location of equipment, a well defined secondary zone can be established

corporating lightning and overload protection are likewise attractive from the safety standpoint. They simplify the pole-top wiring by eliminating the fuse cutout and lightning arrester connections. This contributes to safety by reducing the possibility of contact with live leads and by simplifying the installation of rubber protective equipment.

Adequate Capacity . . . Suitable load switching facilities render use of fuse cutouts for picking up or interrupting the heavier loads unnecessary. This can be attained by supplementing the fuse cutouts in areas of high load density with pole-mounted, three-pole oil switches. Several utilities have reported difficulty in using fuse cutouts for switching. There is a need for a low-cost fusible device having load-breaking ability. Accident records include instances of men sustaining flash burns as a result of attempts to pick up or interrupt load with fuse cutouts.

Accessibility . . . Fusing, switching, and sectionalizing equipment that might be operated under adverse conditions should be located so that it can be reached and operated from a safe position. Fuse cutouts, particularly, should be placed to allow linemen opening or closing the device to work with minimum exposure to energized wires. The men should be in a position where they will not be injured by flashover or failure of the fuse cutout (Fig 2).

Working Space . . . The design engineer can win the gratitude of the lineman by creating a working space that allows ready access to equipment, freedom of movement, and less application of rubber goods. Long vertical taps to equipment below the line arm can, if not properly covered with rubber goods, be sources of electrical contact. Construction of this type can be eliminated by mounting the transformer on the line crossarm. But if drop construction is used, the distance between the line arm and the transformer should be held to a minimum with the secondary conductors placed below the transformer so that a well defined secondary zone is established. Fig 3 illustrates a possible riser situation and its correction. Fig 4 demonstrates how longer crossarms can increase working space and permit the elimination of the pole-top pin in the construction of medium voltage lines.

Fewer Crossarms . . . Reduction in the number of crossarms supporting line wires at different levels on the same pole is desirable in order to avoid the compact nature of multi-arm construction. These difficulties although surmounted by skilled men slow up their efforts and place them in positions where exceptional care must be taken in executing their assignments. Use of longer crossarms for supporting distribution conductors and the installation of secondary leads on racks provide a means of establishing a setup where the function of all elements is evident, the need for additional crossarms is reduced, and all maintenance operations are simplified (Fig 5).

No Booby Traps . . . Hardware items normally dead occasionally become energized. The principal offender is the steel crossarm brace. It appears in the description of ten fatalities in the 1944-1949 summaries (Fig 6). Wood braces neutralize these hazards and provide additional dividends in lightning protection.

Steel braces are not the only item of pole hardware susceptible to accidental energization. Bolts used for mounting transformers with ungrounded cases directly on the pole or supporting street light brackets can also present points of contact with

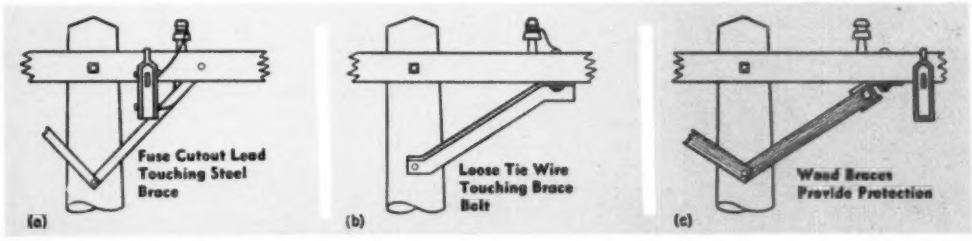


FIG 6—FUSE CUTOUT LEAD (a) touching a steel crossarm brace is a hazard. Vertical bolts (b) in contact with loose line wire or tie may energize the brace. Wooden braces (c) minimize both types of hazards and provide additional dividend of better lightning protection

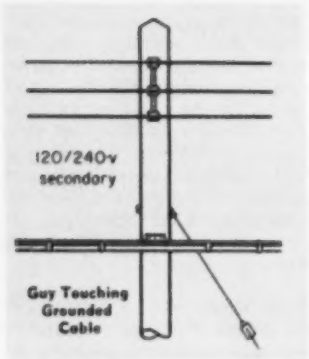


FIG 7—GUY TOUCHING communication cable or messenger can constitute unsuspected ground path for lineman working on secondary

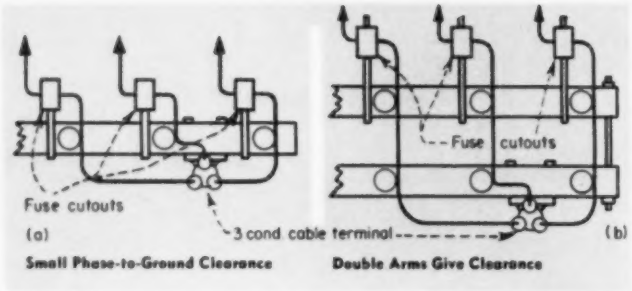


FIG 8—SINGLE ARM may (a) lead to small clearance of live leads of fuse cutouts from bolts supporting cable terminal. (Skinning knife in hands of lineman could create a short circuit.) (b) Double-arm construction affords safer clearances for lineman

line potential should the case of the transformer or the street light fixture be energized by insulation failure. Proper remedial steps might require grounding cases, recourse to crossarm mounting of transformers, providing insulating shields for the bolt heads, use of lag screws instead of through bolts for fastening street light brackets, or the eliminating of interior fixture wiring on series circuits.

Grounded Equipment . . . Utilities operating 12-kv or higher voltage systems, worked mostly with hot line tools, usually ground equipment cases and guy wires. Where lower voltage systems are involved and all classes of maintenance are performed with rubber goods on live equipment, pole-top grounds are generally restricted.

It must be remembered that work on 120-v lines can be extremely hazardous in the presence of grounded objects and that rubber gloves and sleeves are a must for linemen working under such conditions. One lineman was made uncomfortably aware of this when he sustained a shock, without serious consequences, when his foot touched a guy contacting a ground communication cable while he was working with leather gloves on 120/240-v secondary conductors on a rainy day (Fig 7). More tragic was the fate of a lineman covered in the 1947 Accident Prevention Committee Summary who simultaneously grasped a 120-v secondary conductor and a grounded guy wire.

Ground clearance is likewise important in pole wiring where proper separation must be maintained between live leads and grounded objects. This was recently illustrated when a lineman working on a pothead arm, that also supported three fuse cutouts, grounded with his skinning knife a fuse cutout lead to one of the bolts supporting the pothead bracket (Fig 8).

Climbing Space . . . Climbing space is fundamental. Junction poles are critical points in this respect. Direct ascent, possible when longer crossarms are used, is recommended as preferable. Climbing spaces of 30 in. are standard, but some utilities have settled on a 40-in. value. At junction poles climbing space can be increased by using longer crossarms and leaving the pole pins unoccupied.

New Developments . . . Some developments include (1) the use of insulated leads for pole-top wiring, (2) elimination of risers by enclosing conductors in conduit, (3) more extensive use of multiple street lighting circuits, and (4) application of aerial cable.

Shielded aerial cable provides a means for eliminating many common causes of pole-top accidents. It reduces the entire pole top to ground potential (Fig 9). The shielded aerial cable feeding the bank of transformers on the platform is not terminated at the primary grade but is continued downward from the messenger to the fuse cutouts thereby eliminating the open wiring commonly used for this purpose. A railing and walking board are installed for safety purposes.

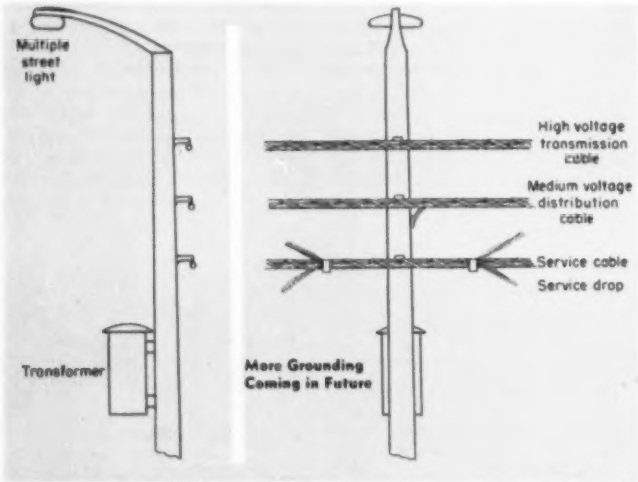
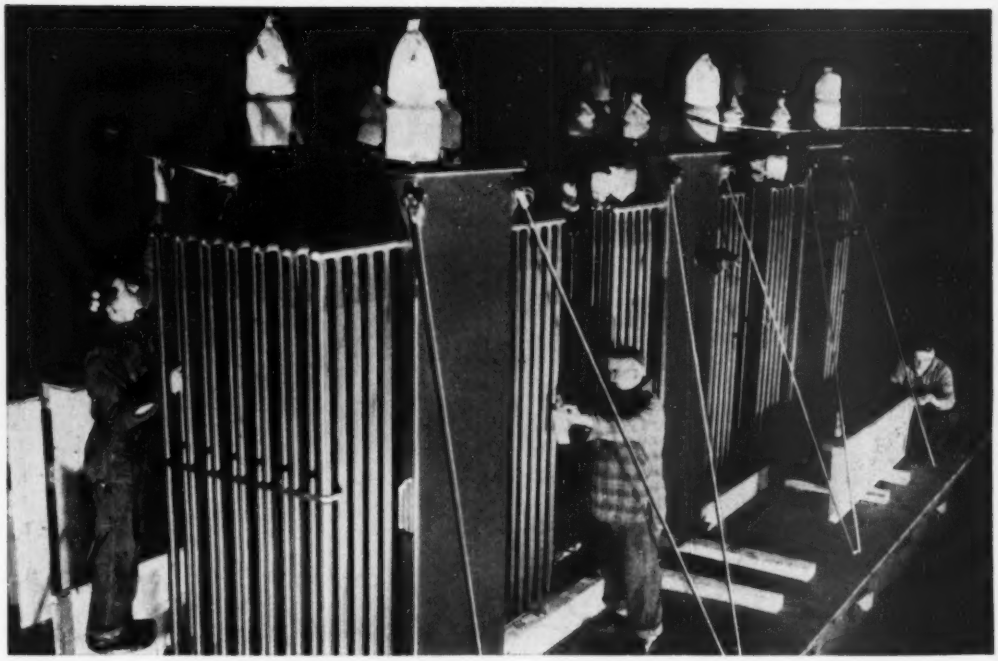


FIG 9—FUTURE STRUCTURES may be completely grounded, comprising aluminum pole with internal wiring, sheathed aluminum aerial cables. All line work would be performed easily and safely by lineman on truck-mounted insulated ladders and platforms



89 Different Electric Utilities Specified RM* Transformers in 1951...gain of 15.6% over 1950

RM designs now conform to new ASA Standards... faster shipments, lower prices are retained

Our records for 1951 show that 89 different electric utilities capitalized on the shorter shipments at lower prices obtained by specifying General Electric's RM power transformers. This represents an increase of 15.6% over the 77 utilities that placed RM orders in 1950.

In terms of actual volume, RM units accounted for 59.2% of all orders for power transformers in the RM range—convincing evidence of their wide acceptance, and of the flexibility in application they offer.

This year we anticipate even wider acceptance of RM transformers which now conform to the new Proposed Standards for Transformers, recently adopted by the users and manufacturers represented on the ASA C-57 Committee. These new RM ASA transformers offer the same price and delivery advantages as previous RM designs.

For complete information on the new ASA Standards, and on RM ASA transformers, see your local G-E representative. Or write to *General Electric Company, Schenectady 5, New York.*

*RM stands for "Repetitive Manufacture." By using standardized construction methods, General Electric builds RM power transformers more economically — delivers them faster. RM designs are available in ratings 10,000 kva and below and up to 69 kv, with many optional features.

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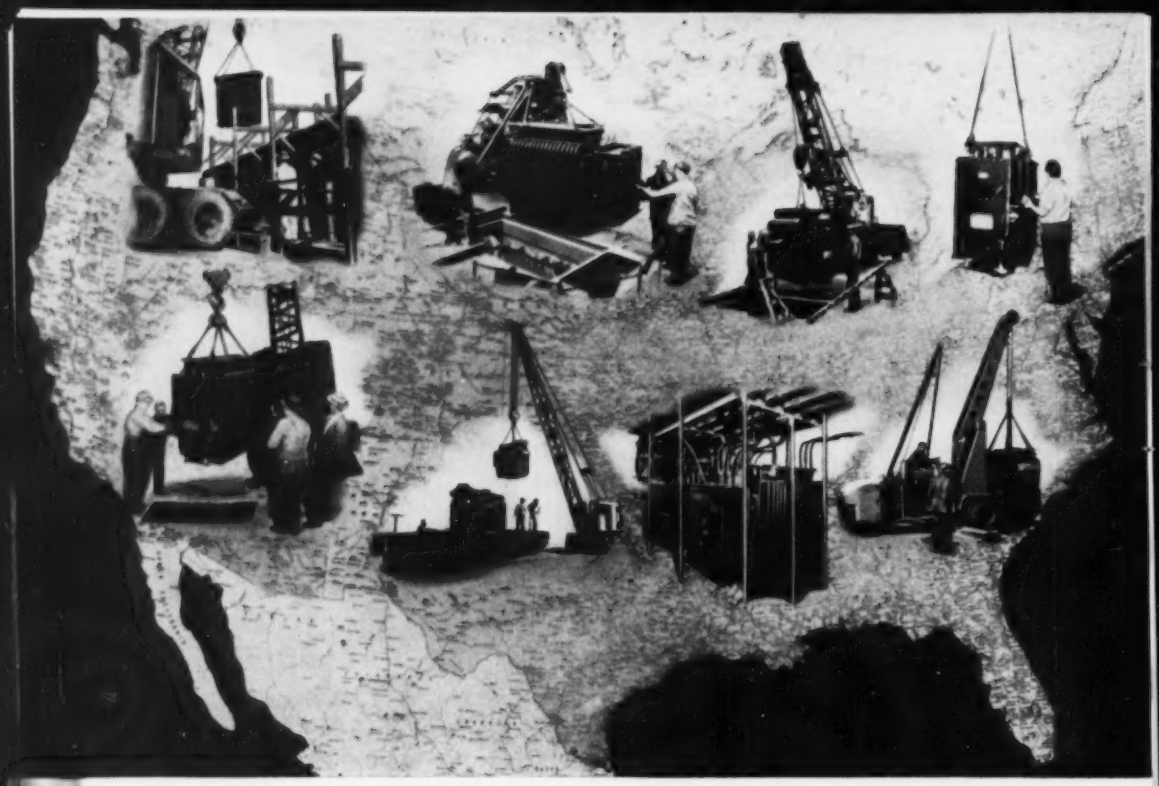


Secondary networks key to easy expansion in city after city across the nation

G-E network units added by many utilities . . . often as only step in increasing system capacity

Even today's rapidly expanding urban loads cause little difficulty in cities where secondary network systems have been installed.

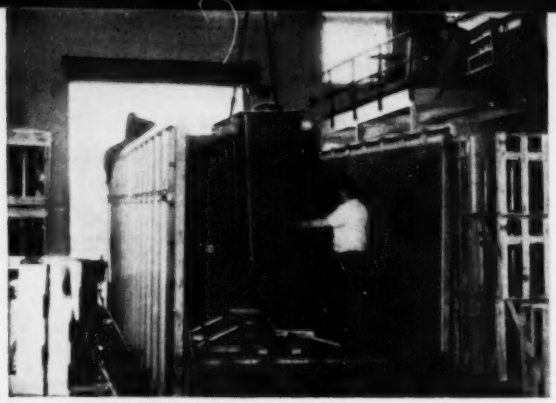
Unlike radial distribution systems, secondary networks permit electric utilities to handle increased loads—foreseen and unforeseen—without resorting to extensive engineering calculations, rearrangement or bolstering of circuits, or juggling of existing loads. And this, in addition to maintaining virtually uninterrupted service and uniformly firm voltage!

The installations pictured on the right clearly demonstrate the ease of meeting load growth once you have gone to a secondary network. In practically every case, all that was necessary to take care of increased loads was additional network units. Where required, utility crewmen constructed transformer vaults; installed new G-E network transformers; and tapped them in to reinforce existing secondary grids!

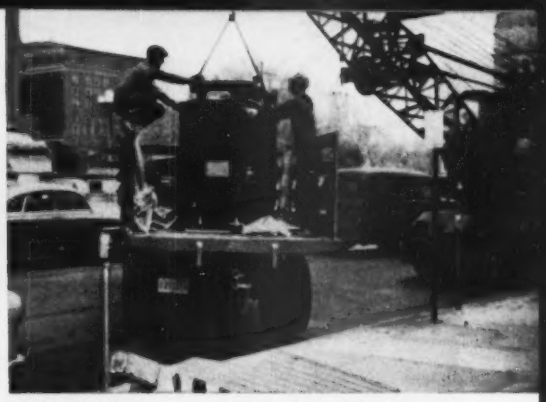
If you're struggling to accommodate new loads by perpetuating a radial system and your load density has risen to approximately 10,000 to 15,000 kva per square mile, it may be time for you to investigate the flexibility and economy of a secondary network.

When you do, be sure to consider the extra advantages of G-E standardized network equipment. Quantity production methods reduce manufacturing and assembly time. You get faster delivery at lower prices. And refinement in design made possible by quantity production means lower installation and maintenance costs.

For help in solving your network problems and for complete information on G-E network transformers, see your local G-E representative. Or write for Bulletins GEA-5024 and GEA-2017. *General Electric Company, Schenectady 5, New York.*



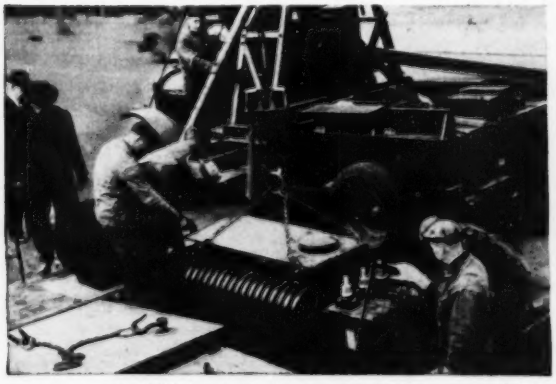
PROVIDENCE Narragansett Electric Company prepares to add another G-E network unit. An overhead crane eases unit into truck for transportation to vault site.



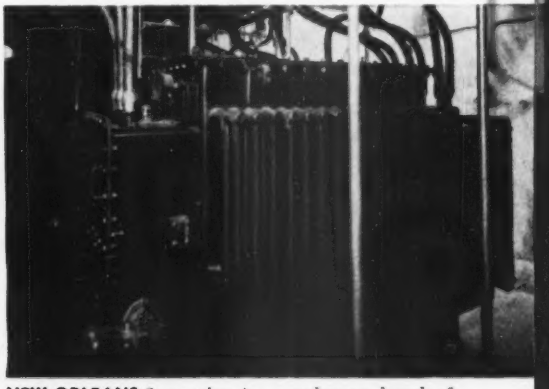
INDIANAPOLIS Crewmen of the Indianapolis Power & Light Company rig a new G-E network transformer to be transferred to sidewalk vault on North Pennsylvania Street.

SACRAMENTO And still another General Electric network transformer being added. Workmen are guiding suspended unit towards vault opening.

SAN FRANCISCO adds capacity in heart of "down town" district. G-E standardized network unit enabled Pacific Gas & Electric to construct vault of minimum size at Pine St.



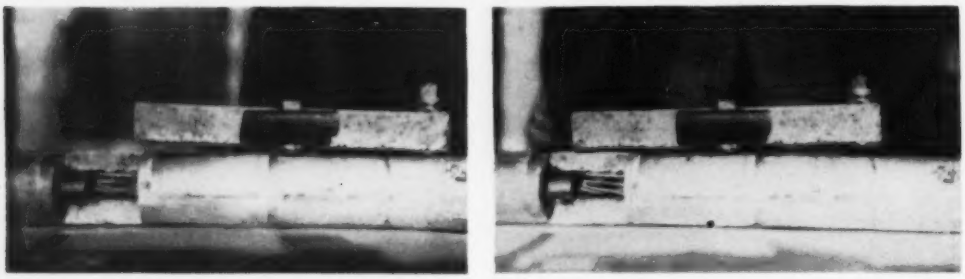
ST. LOUIS and the location is Clark Avenue and 15th Street. Union Electric's crew will soon have this standard G-E network unit in place and connected to secondary grid.



NEW ORLEANS Scene taken in an underground vault of the New Orleans Public Service system shows G-E network units connected up and ready to handle their share of load.

GENERAL ELECTRIC

412-119



STEEL SLEEVE LOCATOR works effectively on ACSR. As both ends of magnet attract steel cable equally, the counter-weighted end does not rise (left). As locator reaches steel sleeve, however, added magnetic attraction pulls unweighted end down, indicating sleeve end

Magnetic Device Locates ACSR Joints Accurately

A. S. RUNCIMAN, Superintendent Communication Division & Transmission Engineer, The Shawinigan Water and Power Co, Montreal, Can.

A device for locating steel sleeves in aluminum compression joints on ACSR has lessened the chances of improper centering of steel sleeves at joints. Improper centering causes heating problems at the joints.

The locator is a bar of No. 5 Alnico, 8-in. long with a 1-in. cross section. It is encased in sheet copper, because of the brittleness of Alnico. The magnet is then mounted to balance in simple bearings on a brass slide so the magnet can be easily moved along the conductor. When the magnet approaches the steel sleeve inside the aluminum sleeve, the end of the magnet dips positively. Reversing the procedure, locates the other end of the sleeve.

This device has proven more successful than the bolometer, because of the latter's weather limitations. The bolometer can only be used for temperature measurements when there is a plain blue sky as a background for the conductor.

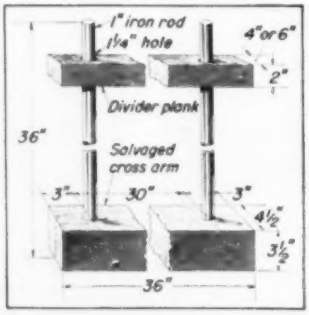
The locator is the result of work directed by Arthur Sisson of the Quebec Terminal Staff of The Shawinigan Water and Power Co. It was used extensively and successfully on the ACSR transmission line changeover between Quebec and Isle Maligne. This changeover consisted of taking down existing ACSR, sending it to a factory for additional layer of aluminum strands and then restringing the conductor. This operation resulted in larger diameter conductors, increasing the power capability of the circuit and raising the corona limit.

Material Rack is Simple, Safe, and Low-Cost

M. J. MOREE, District Storekeeper, The Ohio Power Co, Portsmouth, Ohio

Storage of anchor rods, ground rods, conduit, pipe, etc. was a problem until the simple, inexpensive method illustrated was devised. It meets the general requirements of: (1) Safety; (2) protection of material; (3) convenience; (4) accessibility for withdrawals and accurate inventory; and (5) neatness and uniformity.

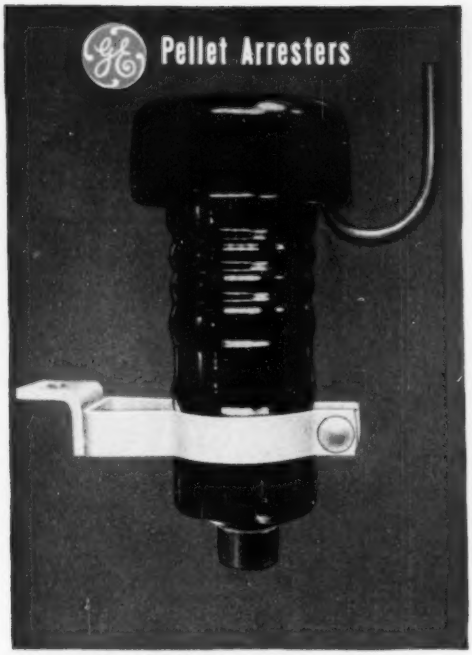
The storage method has proved very satisfactory because the rack may be placed in any position to meet requirements. Cost is small because salvaged materials can be used and little labor is required.



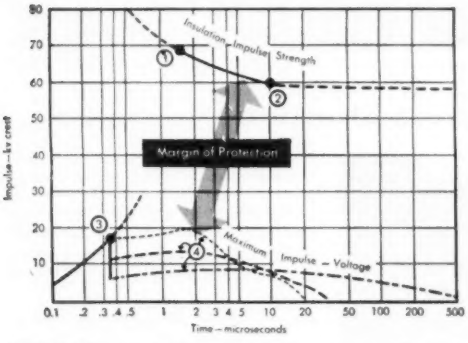
STORAGE METHOD for anchor and ground rods is provided by rack assembly shown in outline

Main features of this rack are the adjustable, removable dividers which give accessibility of stock for removal or quick inventory, and the upright side rods which give stability to the stack and prevent damage. This rack will hold as many as 280 rods stored in 8 bundles of 5 rods each or 40 rods per layer. The base plate is cut from an old steel-pin crossarm, the dividers from 2x4-in. or 6-in. pine board from crating, and the side rods from 1-in. round iron salvage stock.

Previously anchor rods were stacked in bundles of 5 rods each, as furnished by the shipper. Tiers were made and separated with suitable boards. The proportions of the pile were adapted to the amount of stock on hand. To afford additional stability, the material was customarily stacked alongside a building wall or something substantial. However, this created a potential hazard.



THE G-E PELLET ARRESTER is also unequalled in durability—the only distribution arrester with series gaps sealed in dry, inert nitrogen. Gap electrodes stay bright as new. The Pellets, themselves, are unaffected by service moisture.



THIS GRAPH was made from actual volt-time and ampere-time oscillograms, and from AIEE standard test data. The demonstrated impulse strength of 2400-volt distribution transformer insulation is represented by the curve passing through: (1) the minimum impulse strength on an AIEE standard chopped wave test, and (2) the minimum impulse strength on an AIEE standard full wave test. The impulse voltage allowed by a 3-kv General Electric Pellet Arrester is determined by (3) the impulse sparkover voltage of the arrester on the AIEE standard test wave, and (4) the IR drop across the arrester to ground with (top line) a 65,000 ampere discharge—(middle line) a 20,000 ampere discharge—and (bottom line) a 1500 ampere long duration discharge. The arrows show the unequalled margin of safety.

No other distribution arrester protects so well

HERE'S THE EVIDENCE. The graph below, from actual volt-time and ampere-time oscillograms, shows the unequalled margin of safety that a 3-kv General Electric Pellet Arrester gives a 2400-volt distribution transformer. Higher rated arresters, protecting higher-voltage transformers, similarly show this unequalled margin of protection.

HERE'S THE REASON. This extra protection results from a combination of low sparkover voltage *and* exceptionally low IR drop. Whether lightning currents are high or low, with durations long or short, *no other distribution arrester holds voltages to such low levels.*

HERE'S YOUR CUE. The Pellet is a valve-type arrester for universal use on urban, rural, or industrial systems. It is available in ratings of 1 kv to 15 kv inclusive. This arrester has been *the* quality-standard for over 25 years—it's your cue for maximum protection. For further information contact your G-E representative or your authorized G-E agent.

Apparatus Department,
General Electric Company,
Schenectady 5, N. Y.

GENERAL ELECTRIC

405-36

Retap Motor Frames Quickly and Accurately

E. H. TYSON, Supt of Meters, Pennsylvania Power & Light Co, Hazelton, Pa.

Retapping of demand register motor frames has been turned into a quick and simple operation with uniformly good results by a tapping attachment device. Formerly the operation was a slow process with but variable results.

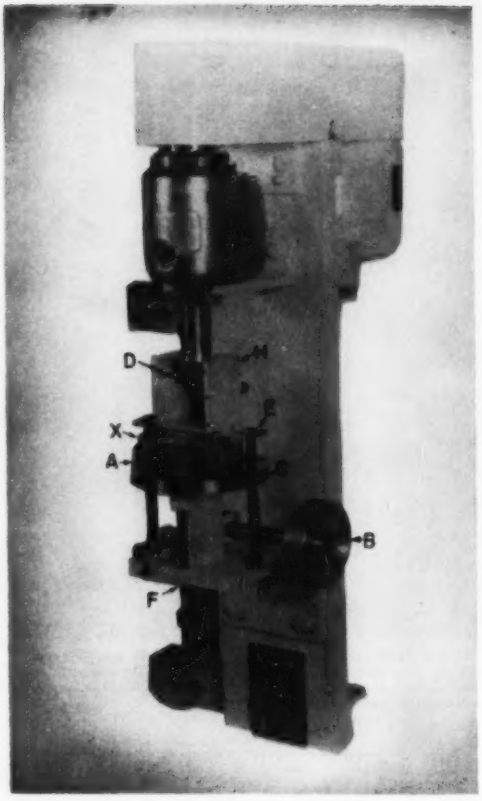
The device retaps screw holes of the top motor frame of Westinghouse RW-2 demand registered motors. Retapping removes shellac which may be in threads from the joint. The device has reduced the time required to tap the screw holes by 75%.

The device can best be described by telling how it operates. In the accompanying illustration, a drilling block (A) holds a motor frame (X) while it is being tapped. Seven holes thru the block are centered carefully in direct line with the holes in the frame.

By placing a hole in the block over a centering pin in the base plate (C), the hole in the frame directly above the center pin is in position for tapping. Turning the large knurled hand wheel (B) raises the base plate and allows a clamping bar (E) to hold the block and frame against the base plate. This bar prevents the block from moving.

As the unit is raised, a hard bristle brush cleans the tap (D) before and after the hole is retapped. An enclosed housing or safety guard (H) has a Plexiglas front mounted on the clamping bar. This housing encloses the tap and prevents the operator's hands from coming in contact with it. A hinged back permits cleaning the housing.

Pulleys on the motor and the attachment are covered with a safety guard housing. An adjustable rod (F) attached to the base plate controls its travel.



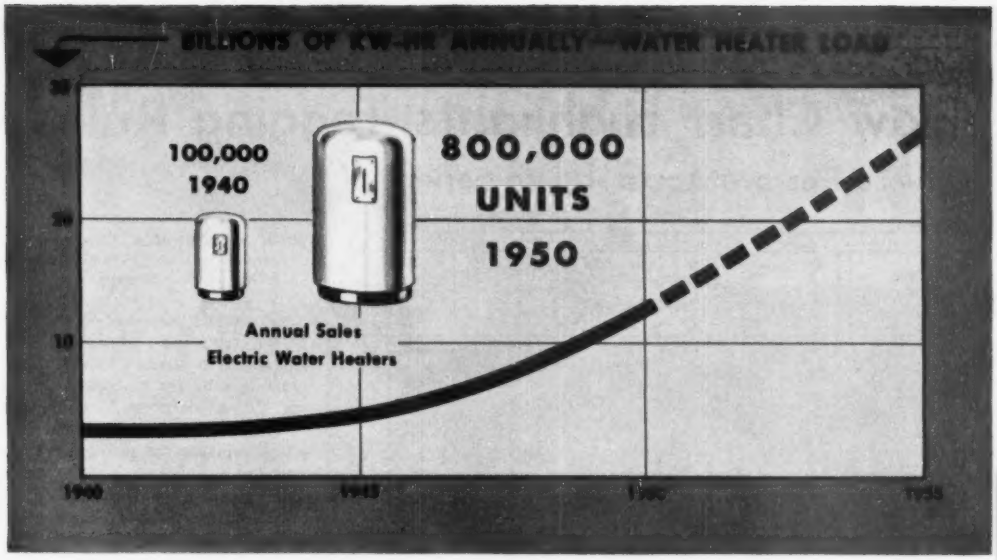
Energy Absorber Eliminates Concrete Structure

ENERGY ABSORBER installed by Los Angeles Department of Water and Power bypasses high-head water into a lower reservoir. Water head loses almost all its energy in device

A. E. BRATFISCH, Hydraulic Engineer, Los Angeles Dept of Water and Power

Absorption of high-head energy is the function of a device fabricated and installed by the Los Angeles Department of Water and Power at their Franklin hydro plant north of Los Angeles. The energy absorber bypasses water which normally drives turbines in the plant before it goes into a lower reservoir.

The absorber is made of four pairs of opposed nozzles which will handle 250 sec-ft of water under 200-ft head. It was made by the American Pipe & Steel Corp for the Department. It consists of four straight pipes welded perpendicularly through a length of larger pipe which serves as a low pressure chamber. Center sections were cut out after the completed structure had been stress relieved. Connection is made from the penstock to each pair of nozzles by a cutoff valve.



The Growing Water-Heater Load... Problem or Opportunity?

By 1955 the water-heater load will be almost double what it is today. With defense needs limiting plant expansion, how can this increase best be handled?

Today water heaters account for 13,500,000,000 KW hours annually—20 per cent of the total domestic load—yet only ten per cent of U.S. homes are currently using electric water heaters.

LOAD INCREASING 8-FOLD

Before World War II electric water heaters sold at a yearly rate of 100,000 units. They are now selling at an average of 800,000 units per year. This yearly increase of 2,400,000,000 KW hours on the national load greatly intensifies the problem with which utilities are faced: *How can expanding water-heating loads be added most economically to existing systems?*

The answer to this problem where pronounced peak loads occur, can be found in today's improved methods of off-peak control of electric water heaters, either time switch or 720-cycle.

AN ECONOMIC PROBLEM

No one questions the efficiency of off-peak control—the problem is basically one of economics. Therein lies opportunity for the nation's utility companies.

This opportunity lies in the power made available by the use of off-peak control. Of the total water heaters now in use, only half are presently being served by off-peak control—at a yearly saving of 1,350,000 kilowatts of peak demand—more than enough capacity to supply the entire needs of the state of Connecticut. By solving their increasing water-heater load problems, many utilities are currently releasing much-needed capacity for the vital defense program, at the same time increasing the load factor of the system.

Compared with an average cost per heater of $25 to $50 for off-peak control, investment for added peak-load capacity may be five times as great, or more. This type of control also saves appreciable amounts of scarce copper that would otherwise be required for expanded facilities.

SYSTEM STUDIES NEEDED

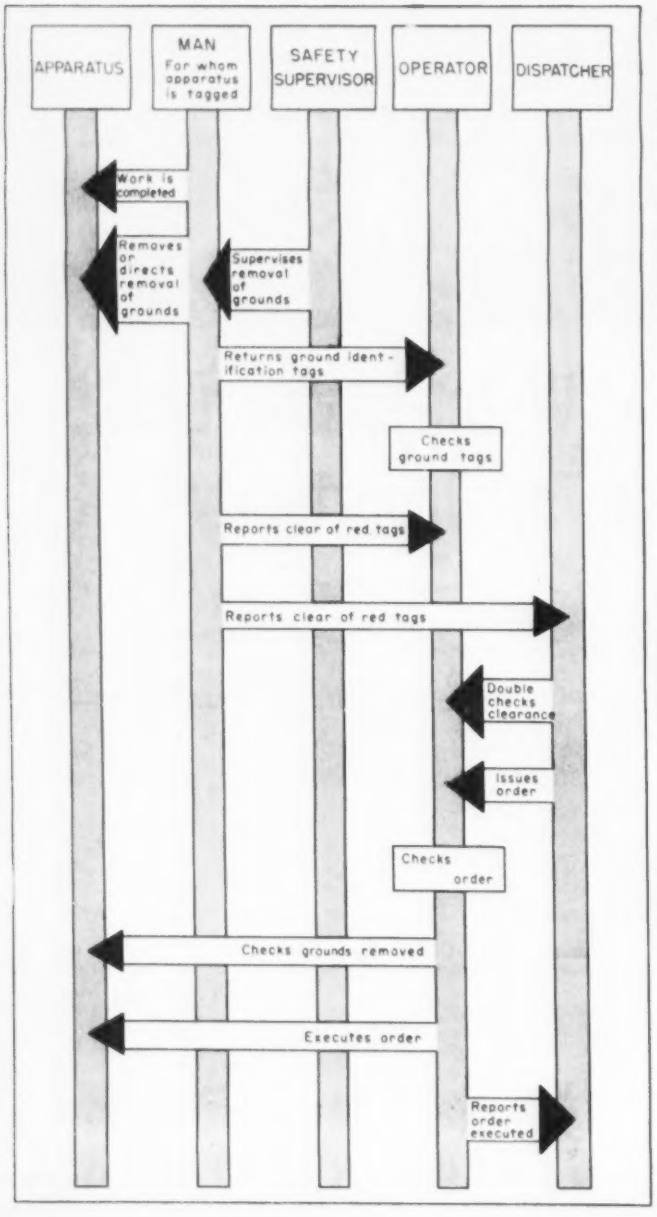
A thorough study of the economics of off-peak control is necessary if proper evaluation of individual requirements is to be made. Your General Electric Apparatus representative is prepared to discuss with you the possibilities which off-peak control may offer your own situation. For a more detailed report on the subject, write for GEA-5686: "Economics of Off-peak Control," *General Electric Co., Schenectady 5, N. Y.*

GENERAL ELECTRIC

603-131

Flow Chart Highlights Tagging Rules

II—To Restore Apparatus to Service



JOHN W. GRONBECK, Superintendent, Electrical Operation, The Narragansett Electric Co, Providence, R. I.

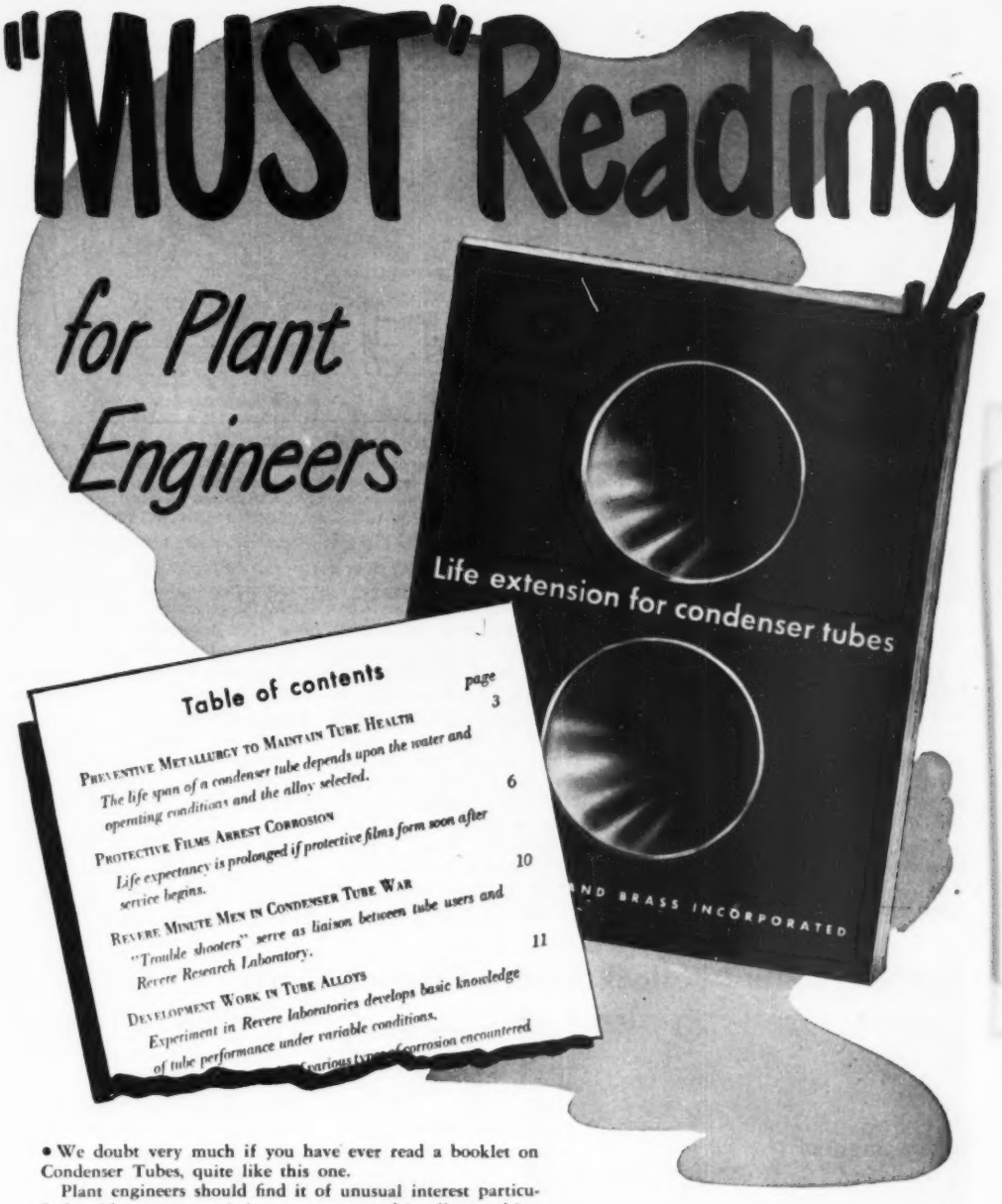
Chart outlines procedure for removal of red tags, and for restoration of equipment to service. This flow-diagram, used by The Narragansett Electric Co, is based on New England Electric System's tagging rules to safeguard men and to govern work on electrical equipment. Another chart gives procedure for removal of equipment from service and placement of red tags. (See ERS No. 52-9; EW, May 5, 1952)

The Narragansett Electric Co.
SAFETY FIRST
Before working on any apparatus, conductor or cable it is your duty to test the equipment for potential and ground, and short circuit it as required by the tagging rules

Contents on opposite sides of red colored tags

RED • TAG
Switch No.
Station or place — Date
Apparatus protected
Tagged for — At
By operator — Ordered on by
Ordered off by — By operator
At — Date
Safety supervisors

"MUST" Reading for Plant Engineers


Life extension for condenser tubes
Table of contents
page
PREVENTIVE METALLURGY TO MAINTAIN TUBE HEALTH
The life span of a condenser tube depends upon the water and operating conditions and the alloy selected. 3
PROTECTIVE FILMS ARREST CORROSION
Life expectancy is prolonged if protective films form soon after service begins. 6
REVERE MINUTE MEN IN CONDENSER TUBE WAR
"Trouble shooters" serve as liaison between tube users and Revere Research Laboratory. 10
DEVELOPMENT WORK IN TUBE ALLOYS
Experiment in Revere laboratories develops basic knowledge of tube performance under variable conditions. 11
various types of corrosion encountered

• We doubt very much if you have ever read a booklet on Condenser Tubes, quite like this one.

Plant engineers should find it of unusual interest particularly with present restrictions on copper and its alloys making it more important than ever that every last ounce of use be squeezed out of the condenser tubes in their plants.

This 28-page booklet includes data on various copper alloys, photos of cut-away tube sections showing various types of corrosion encountered in condenser tube service and photomicrographs showing the grain structure of different kinds of metals under varying operating conditions.

Send for your copy today. Please make request on your firm's letterhead. Thank you. Address Department E.W., Revere Copper and Brass Incorporated, 250 Park Avenue, N. Y. 17, N. Y.

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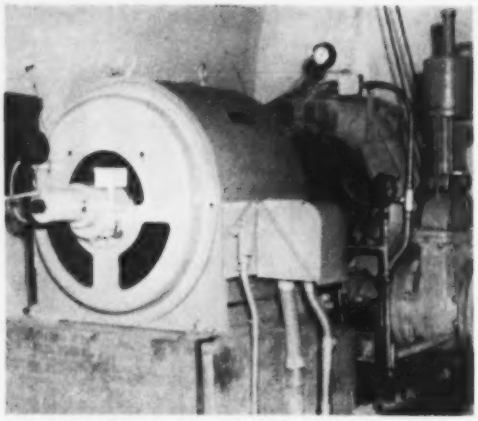
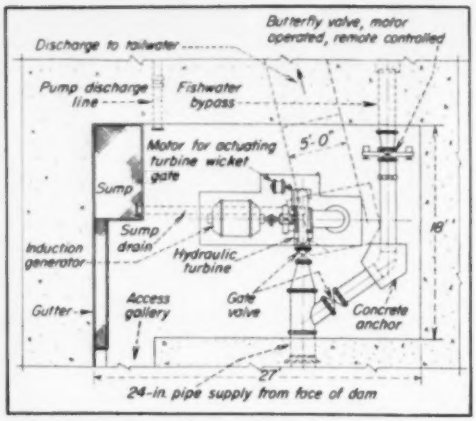


"FISH WATER TURBINE" installed by Southern California Edison to extract up to 350 kw from water (at 222-ft head) required to maintain minimum downstream flow and fish life below its new Big Creek 4 plant. Induction generator operates under supervisory control



POSSIBLE FLOODING of turbine room during heavy flow season when tailwater backs up is stopped by sealing turbine base, making it watertight. Supervisory control operates turbine wicket gate and by pass valve from main control room, telemeters generator output river flow

Use Bypass Water in Small Turbine

To prevent wasting potential kilowatt hours during the season when they must pass water to maintain minimum flow downstream, Southern California Edison installed a small turbine in a gallery of the dam at its Big Creek 4 plant. It drives a 350-kw induction generator which is connected through a 500-kva transformer bank and high side oil switch to an 11-kv line serving Edison loads in the area.

Under terms of the license for the plant, water must be released from the dam reservoir whenever the natural runoff downstream falls below 20 sec ft—which happens nearly every summer. Water flowing at 222-ft total head through the horizontal reaction turbine drives the 1,200-rpm 2,400-v generator, then exits downstream to maintain the required flow of water to the river.

Supervisory control from the control room of the main powerhouse operates the turbine gates to regulate load and to open and close the turbine by-pass valves. It also operates the oil circuit breaker on the high side of the 2,400/11,500-v transformer bank. The same circuits serve to telemeter the generator output, as well as flow of a downstream tributary and total downstream flow. Standard relays protect the generator against damage from reverse power, grounding, and overload.

Since tailwater level at times of flood may rise above the level of the turbine room floor, the base of the turbine is sealed and water tight to prevent flooding. A motor driven blower in the room brings air in from an adit in the dam to keep moisture from the concrete walls down to a reasonable amount.

Two Keys and Interlock Assure Safety in Tests

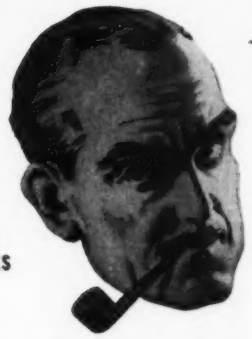
MECHANICAL INTERLOCK (arrow) between test-cage door and adjacent main power switch and the provision that two keys be used assures safety in high-voltage laboratory testing

M. H. STEVENSON, District Meter Supervisor, and **E. R. HILL,** District Electrical Engineer, Appalachian Electric Power Co, Logan, W. Va.

The laboratory installation of enclosed high-voltage equipment illustrated combines desirable practices that assure both safety and convenience during testing at Logan.

Safeguards are provided (1) by locks on the cage door and the adjacent main power switch which require the same dual-purpose key; and (2) by use of two dissimilar keys—one special-purpose key and one dual-purpose key which can only be used in the proper sequence. The switch cannot be unlocked to turn on the power

(*Continued on page* 180)



NO. 4 IN A SERIES

a transmission line engineer ASKS—

"is there an insulator that will reduce the effects of air pollutions ?"

here is the ANSWER:

Yes, there is. It is the PINCO L-1925 "UNIVERSAL" INSULATOR which is specifically designed to reduce to a minimum, the damaging effects of fly ash and other air-borne industrial wastes which tend to decrease insulator efficiency and create a costly operational maintenance problem.

and 5 reasons WHY . . .

1. Leakage distance of 17" is approximately 50% greater than 10" suspension unit.
2. Outside petticoats shielded above by bell; below by hood.
3. Long, tapered hood is self-cleaning; acts as a splatter-baffle to clean the petticoats.
4. In strings, interior of hood is shielded by unit below—protected against contamination, thus reducing manual cleaning requirements to a minimum.
5. Standard 5¾" spacing permits replacement of conventional 10" suspension units without re-sagging.

Service records over a period of 20 YEARS

of continuous operation prove that thousands of these Pinco units have met their job requirements 100% in areas where excessive insulator contamination is an operational hazard. Certainly such a record of trouble-free performance proves that they're "right" where it counts . . . right on the job!

PINCO INSULATORS

The Porcelain Insulator Corporation ★ LIMA, NEW YORK

Sales Agents:
Joslyn Mfg. & Supply Co.
Offices in
Principal Cities

OA

OW

OW/A

OA/FA

OA/FA/FA

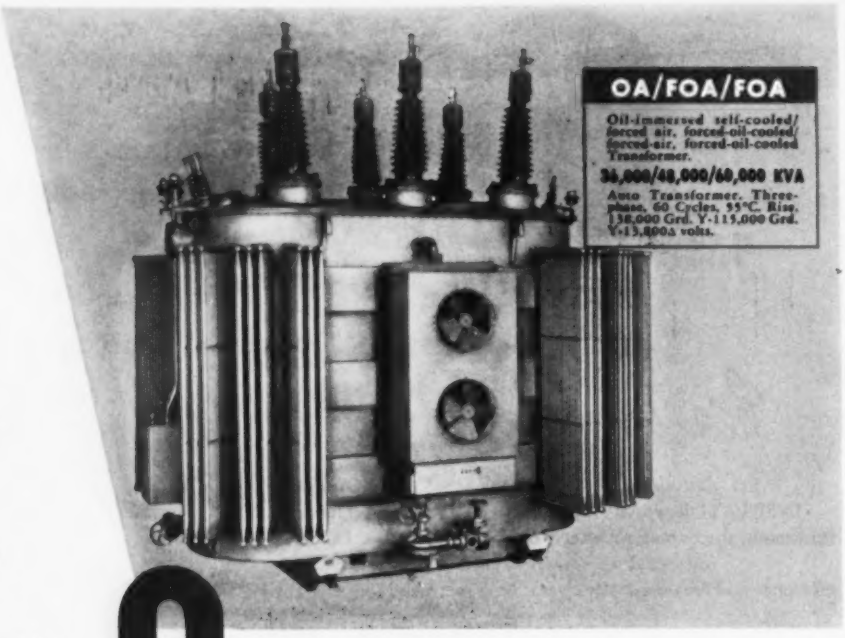
OA/FOA/FOA

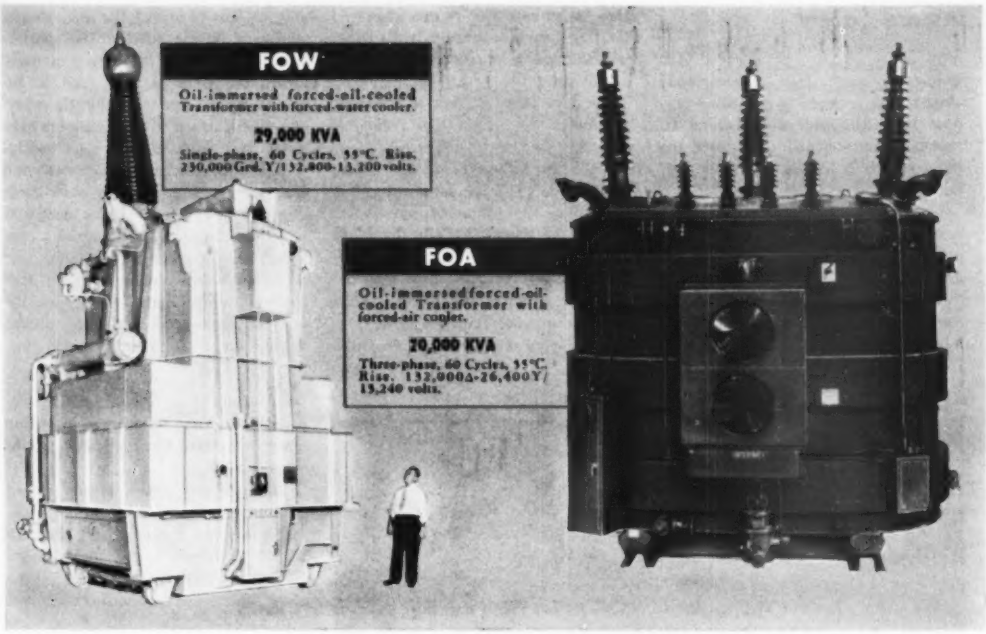
OA/FA/FOA

FOW

FOA

9 ways to cool an Oil-


OA/FOA/FOA
Oil-immersed self-cooled/forced air, forced-oil-cooled/forced-air, forced-oil-cooled Transformer.
36,000/48,000/60,000 KVA
Auto Transformer, Three-phase, 60 Cycles, 55°C. Rise. 138,000 Grd. Y-115,000 Grd. Y-13,800Δ volts.


FOW
Oil-immersed forced-oil-cooled Transformer with forced-water cooler.
29,000 KVA
Single-phase, 60 Cycles, 55°C. Rise. 230,000 Grd. Y/132,800-13,200 volts.
FOA
Oil-immersed forced-oil-cooled Transformer with forced-air cooler.
20,000 KVA
Three-phase, 60 Cycles, 55°C. Rise. 132,000Δ-26,400Y/15,240 volts.

filled power transformer

According to NEMA Standards, oil-filled transformers can be cooled in nine different ways. The manner of cooling depends upon many considerations, such as the operating characteristics of transformers using various types of cooling; the availability of large quantities of water; and what is very important, the economics of selecting one type of transformer over another.

The latter consideration may require some study. Auxiliary cooling methods applied to a self-cooled transformer can add, at relatively low cost, as much as 66⅔% additional capacity to the transformer. On the other hand, the efficiency of the transformer and the cost of operating certain types of cooling equipment may be more important considerations than the initial lower cost of a forced-cooled transformer.

These are matters that can best be discussed between the engineers who specify a transformer and the engineers who design the transformer.

Pennsylvania Transformer Company manufactures transformers of every standard classification and with every type of cooling equipment. If you have a problem in cooling, or for that matter, if you have any transformer problem, you are invited to utilize the experience of Pennsylvania's Engineering Department.

You can make arrangements for a meeting by contacting the Pennsylvania representative in your territory or by writing to Pennsylvania Transformer Company, Box 330, Canonsburg, Pa.

Write for free copy of booklet No. 522 entitled "Economics of Transformer Cooling." This booklet explains the various methods of cooling transformers and discusses their advantages and disadvantages.

Pennsylvania TRANSFORMERS

Pennsylvania TRANSFORMER COMPANY

CANONSBURG, PA. • *Greater Pittsburgh District*

Assure Safety

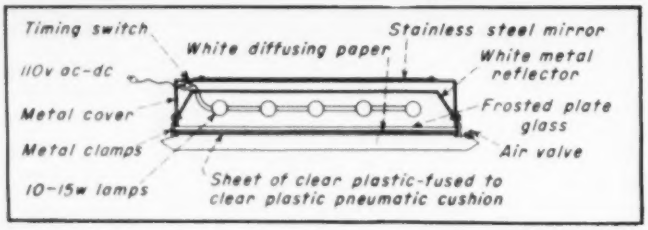
(Continued from page 176)

unless the cage door is completely closed and locked by the dual-purpose key. The cage door cannot be unlocked and opened until after the main switch is locked in the "open" position.

Construction of the cage-door lock is such that the dual-purpose key cannot move or lock the bolt unless the door is completely closed, and unless the special-purpose key is also in the lock. Hence, it is impossible to remove the dual-purpose key from the door to unlock the power switch if the cage door is even slightly ajar, or if the special-purpose key has been removed.

The dual-purpose key is securely attached to the door by a flexible steel cord so it will always be readily available for either the door or main-switch lock. The special-purpose key is kept in one barrel of the duplex door lock, except when the test cage is unattended by a technician, to permit operating the door lock with the dual-purpose key. When this special key is removed, it is impossible to lock the door and remove the dual-purpose key to unlock the main switch and turn on the power. The special-purpose key can be removed only while the door is ajar and is retained by a responsible person while the cage is unattended so cleaners may enter and work in the cage safely.

All high-voltage equipment and leads are housed in the wire-mesh cage which extends to the ceiling and is located in a corner of a room providing natural lighting through two windows. Low-voltage (not over 240 v) controls are placed outside and adjacent to the cage permitting full view of equipment under test.



PHOTOSTAT MACHINE produces reversed-lettering and direct-lettering negatives. It will produce copies of bound pages or translucent loose sheets. This device operates on 110 v

Photostat Machine Cuts Copying Time

PAUL H. De WALT, Engineering Dept., Indiana & Michigan Electric Co., Marion, Indiana

Time and money are being saved in engineering right-of-way work by using a photostat machine which can be carried conveniently in a brief case. With the aid of this portable machine anything anywhere can be copied, even in a lighted room. Either negative or positive prints can be made, and copies are permanent.

Previously, when records at County Court houses throughout the division had to be consulted, right-of-way men had to copy lengthy descriptions of properties by hand. Often return trips had to be made to correct errors in copying.

Time studies have shown that more than 90% of the time required to copy county-ledger records has been saved. For example, 30 legal descriptions which would formerly have required 4.5 man-days for hand copying were photostated in 1.5 hr. After exposures, one man at the engineering office completed the photostats in another 1.5 hr.

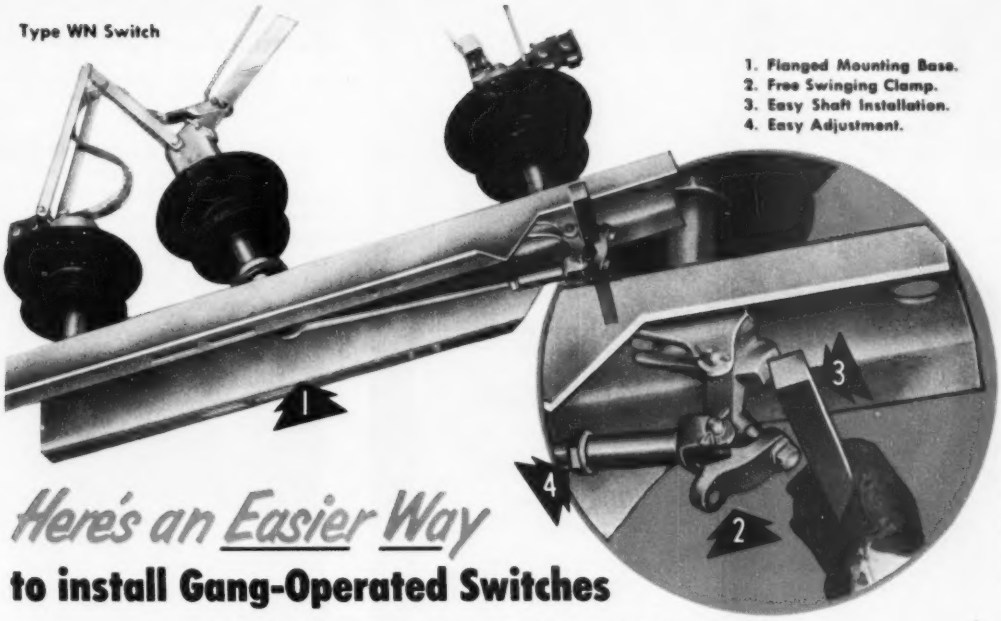
When several copies of any record are required, translucent photostat paper is used for the positive print with additional margin as required. Before making additional prints, the company stations, lines and equipment with necessary notes, title block, borders, etc, are either inked or pencilled on the photostat. Then prints are made on our customary printing machine (blue print, black-and-white, etc).

Recently a drawing of a concrete street-lighting fixture was required. A typical installation was available in a manufacturer's catalog. Rather than spend the time to make a scaled drawing, the catalog page was photostated. Black India ink was then brushed over any undesired data on the negative, leaving only the standard, bracket and fixture. A transparent positive print was then made from this negative and additional information was printed in. The time saved was about three hours.

The "legal" model machine cost $59 in May, 1951. It measures 14.5 in. x 9.5 in. (deep) and weighs less than 7 lb. For operators who do their own print processing, the cost of an 8½ in. x 14 in. copy is about 7 cents, including paper and chemicals; for an 8 in. x 10 in. copy the cost is less than 5 cents.

Components of the machine are shown in the accompanying cross-section view. Assembly is held together by metal clamps on each end of the machine. Stainless steel mirror attached to the top of the box enables direct reading of reversed negatives. Rubber feet attached on one side permit tilting the machine into the vertical position before and after use.

Type WN Switch



1. Flanged Mounting Base.
2. Free Swinging Clamp.
3. Easy Shaft Installation.
4. Easy Adjustment.

Here's an Easier Way
to install Gang-Operated Switches

CHANCE WN-VN SWITCHES

permit quick installation of interphase shaft without "threading"

Chance Tilting Insulator Switches for outdoor gang operation give you always reliable switching under all conditions. The reason? . . . Such operating advantages as the exclusive Compensator Control Mechanism that means positive performance under all conditions—"Crow Bar" Leverage that breaks heavy ice with ease—Compensation for structural warpage—and *New Ease of Installation.*

WN-VN Switches *are* easier to install than any other gang-operated switches. The arrows in the illustration above point out the features that make installation simple.

1. The flanged base has double slots and slotted holes for ready installation on all standard construction. (Front mounting brackets are supplied for steel structures.)

2. The clamp on each switch swings open to permit the interphase shaft to be laid in position *after* the switch units are mounted.

3. The interphase shaft bar is then inserted in all three phases at once—without the necessity of "threading" through small fittings.

4. Easy adjustment (only necessary under unusual conditions*) is accomplished by pulling the stainless steel pin which connects the compensator control rod, loosening the lock nut (4), and turning to adjust.

All control connections on Chance WN-VN Switches are made with clamp type fittings for maximum flexibility.

Rugged "torture rack" tests prove that the performance of these switches is not affected by any conceivable warpage of cross-arms—Ice tests prove their exceptional ability to open and close without difficulty when coated with over ¾" of hard, clear ice. Chance WN-VN Switches can be isolated, while energized, with Hot Line Tools for live line maintenance.

For reliable switching *plus* time saving installation advantages, specify Chance Type WN or VN Switches.

Send for complete catalog information or test data or consult Section 11B of your Chance catalog.

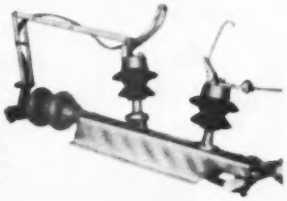
**All WN or VN switches are factory adjusted for proper contact and gap clearance before shipment.*

You know it's RIGHT when you specify CHANCE

ABC INDUSTRIES

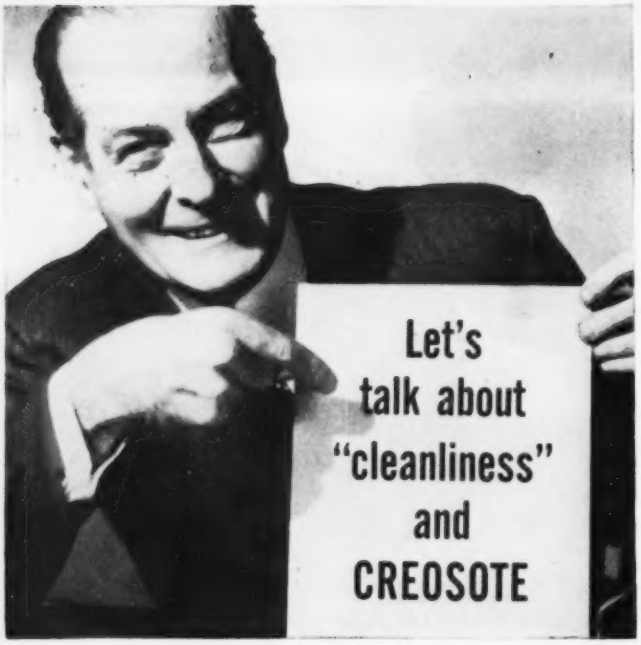
A·B·CHANCE CO.

CENTRALIA, MISSOURI
SAN FRANCISCO, CALIFORNIA



Chance Type VN 200 Amp. Switch. A two-insulator tilting type switch built for service and economy.

C52-10



Today's modern Wood Preserving Plants know how to protect poles with creosote and leave them dry and "clean." Specifications for clean treatment, when combined with proper specifications for the creosote used, provide "complaint-free" poles.

One of the largest producers of pressure-creosoted poles reported to us: "We haven't had a single complaint about the cleanliness of the last million yellow pine poles treated with creosote."

For poles that are *clean*—for poles that *will last*—specify "dry pressure-creosoted poles."

KOPPERS COMPANY, INC., PITTSBURGH 19, PA.
Tar Products Division

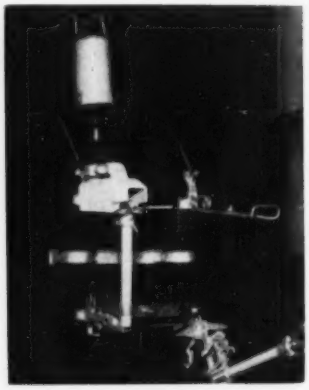
You can count on Koppers for Creosote!

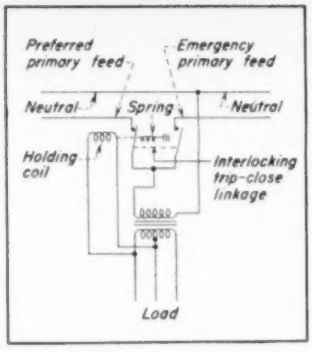
KOPPERS
All Standard Specifications
Creosote
The Performance-Proved Wood Preservative

Low-Cost Switch Transfers Load Quickly

J. F. MILLER, Superintendent, Electric Distribution Dept, Louisville Gas & Electric Co, Louisville

Restoration of service within about 1 sec for such loads as hospitals, radio stations and airway beacons is provided by an automatic, low-cost switch. Based on suggestions by the author, one manufacturer added a secondary holding coil and spring latch to a two-shot repeater fuse and produced a satisfactory device.





AUTOMATIC SWITCH was made from two-shot recloser (top) modified by addition of holding coil and spring latch. When preferred primary feed is deenergized (bottom), holding coil ceases to hold and spring drops fuse cartridge. Momentum of falling fuse closes other fuse on emergency primary feed

The switch is insulated for 7.5 kv, making it suitable for 7.2-kv and 2.4-kv circuits. It will handle 50 amp or 100 kva at 2.4 kv.

In practice, two circuits supplied from the same phase and neutral but from different sources must be avail-

(*Continued on page* 187)

HI-TENSION NEWS *Junior*

25-YEAR-OLD O-B UNITS INSULATE NEW LINE

After 25 years, this line was rebuilt with the original O-B suspension insulators. . . And during those 25 years, these insulators had seen some rugged service. Paralleling a heavily-traveled railroad, the line is constantly exposed to severe contamination and fumes. With the original steel crossarms and inadequate shielding, impulse insulation was low and lightning attack intense. Still the O-B insulators went back into service because these and thousands of others elsewhere on the system had earned the power company's complete confidence. . . For the same feeling of security, make O-B *your* next choice of insulators.

Ohio Brass

MANSFIELD, OHIO, U.S.A.

HI-TENSION NEWS *Junior*

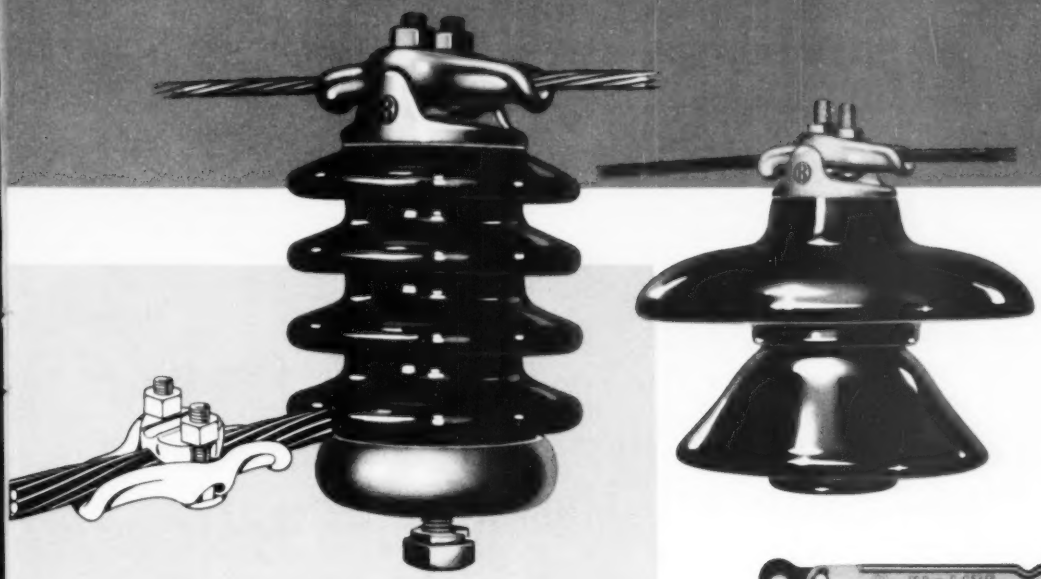
All Alike Just ONE Day

Standards assure you a uniform product when you buy station insulators--uniform the day they are made. But these standards don't specify the *permanence* of these qualities. Durability can't be covered in a set of specifications. It's an unknown factor until you lose it. *Then* you can count your insulator dollars and see if you got a bargain, after it's too late to correct. . . Hundreds of power companies with better than a generation of experience to go on have found how to correct this problem right at the start, however. Put O-B station insulators to work and enjoy the confidence they have earned for nearly 40 years.

Makes a GOOD Insulator BETTER

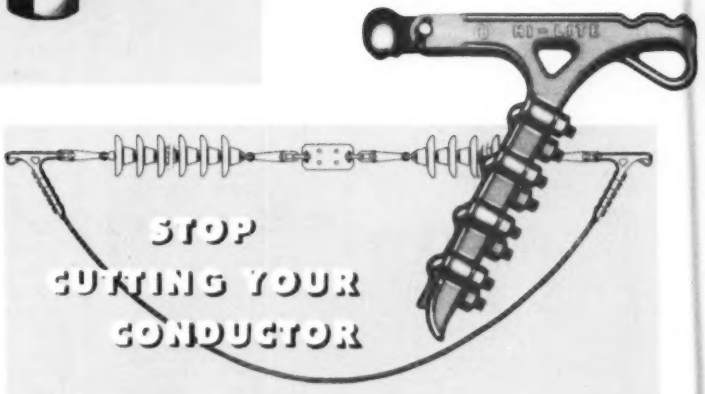
Put the O-B Clamptop on either a pintype or a post and you get a tie connection that can't be duplicated for strength or permanence by any hand serve. Getting rid of the serve also cuts valuable pole-top time, saves a length of tie wire, and greatly simplifies hot stick work. . . Two simple hex nuts replace all serving operations and require only an ordinary wrench to do a 100 per cent job, *that stays done!* . . . Investigate the speed and simplicity of using O-B Clamptops. It will pay you.

Maximum Values



Make Sense

Lightning arrester buyers have often expressed a desire for catalog listings that include *both* average values and tolerance, added up, and stated as "maximum" protective level. Since tolerance cannot be ignored, why not boldly state it? . . . In O-B's new booklet on Thorex lightning arresters we have done just that--showing average values and *maximum values* listed side-by-side for every item. Readers may see at a glance the information they really want. . . They can also see at a glance how much real protection they get when they specify O-B Thorex.



Power conductors don't have to be cut to form jumper loops at strain points--in fact by *not* cutting them you avoid a potential source of serious future trouble. . . O-B Hi-Lite strain clamps attach to the continuous cable in a matter of minutes; take no more equipment than a common hand wrench; call for no special skill; develop the cable's full working strength; can easily be inspected at any time to ascertain full holding power. . . Basically inexpensive both to buy and to use, O-B Hi-Lite strain clamps make possible the modern continuous jumper loop that improves line reliability; and they save money as well.

Ohio Brass

MANSFIELD, OHIO, U.S.A.

HI-TENSION NEWS *Junior*

Not Only Cheap to Buy

...they STAY Cheap!

Are you *sure* all low voltage pintype insulators cost about the same? What does it cost to dispatch a line crew at night to run down an unnecessary insulator failure? That insulator may cost a hundred times what you paid for it! . . . Lightning resistance is a big factor here. A small pintype can't prevent lightning, but it can survive it! That is, it can if it's made properly. . . O-B has applied the talents of the finest electrical laboratory in the insulator business to the problem of lightning damage. We have come up with an insulator, even in the smallest sizes, that will resist the most severe strokes--one that flashes over instead of punctures. You don't pay extra for this and you can't see it in the product, but you won't lay out a hundred times its cost just to hunt it down some stormy night. O-B low voltage pintype insulators are not only cheap to buy--they *stay* cheap!

Ohio Brass

MANSFIELD, OHIO, U.S.A.

4214-I

Low-Cost Switch

(*Continued from page* 182)

able. Depending on system conditions, one circuit is chosen as preferred source and the other as emergency. On the preferred-source side of the switch a holding coil is mounted. This coil is actuated from the secondary of the transformer being protected. A spring of lesser strength opposes the holding coil.

When an outage occurs on the preferred circuit, the holding coil is de-energized and ceases to hold. The opposing spring trips a latch which releases the fuse carrier in the preferred circuit. Momentum of the fuse carrier falling open triggers the emergency circuit fuse carrier into position, restoring service in about 1 sec. Return to the preferred circuit must be made manually. However, when using the same phase, load does not have to be dropped.

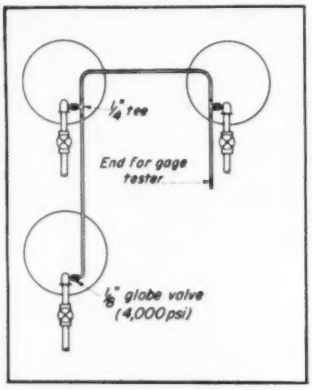
Our company has made 20 installations of this type of switch for hospitals on the system. It can be used in wye connected banks also.

Calibrate Pressure Gages In Place on Panel

WILBUR S. ADKINS, Results Engineer, Windsor Station, Beech Bottom Power Co, Power, West Virginia

Steam pressure gages are being tested in place with considerable saving of time at Windsor generating station. Formerly the gages were disconnected and taken to the shop for calibration. This practice occasioned

(*Continued on page* 190)



STEAM GAGES with back-of-panel tubing reduce calibration time by 83%

BERMICO®
THE CONDUIT THAT SAYS
"STOP!"

To LEAKY JOINTS: Bermico's joints fit tight. No joining compound is necessary. It makes a water-tight joint.

To ACIDS: Bermico is highly resistant to all types of soil acids and alkalies.

To SHOCK: Bermico Conduit is engineered to take the shocks and stresses of transport—the heavy loads imposed during installation.

To ABRASION: Bermico's smooth inside bore assures quick and easy cable "pull through" without danger of abrasion.

To SLOW DOWNS: Bermico's convenient 8-foot lengths are light in weight, easy to handle. Cutting and tooling can be done quickly, right on the job. All joints are precision milled for speedy installation. Bermico's complete line of bends, plus 5° angle couplings, enables you to overcome unusual field conditions without delay.

For fast installation and dependable protection specify Bermico.

Distributed by

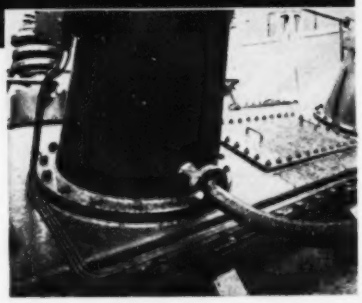
WESTINGHOUSE
Electric Supply Company
Offices in principal cities

BROWN
QUALITY
COMPANY, Berlin, New Hampshire
CORPORATION, La Tuque, Quebec

SOLKA & CELLATE PULPS • SOLKA-FLOC • NIBROC PAPERS
NIBROC TOWELS • NIBROC KOWTOWLS • BERMICO SEWER PIPE, CONDUIT & CORES • ONCO INSOLES • CHEMICALS

What do you mean, it CAN

Well



Safety m.i. Wiring*
in exposed installation
on outdoor
transformer bank.

SAFETY
MINERAL m.i. INSULATED
WIRING
PYROTENAX ®
A GENERAL CABLE PRODUCT

*Exclusively a General Cable Product.

TAKE ABUSE?

SAFETY (m.i.) WIRING

can be hammered, crushed, bent, twisted, jerked —with no impairment of its electrical performance.

Emergency overloads can't hurt it. Age causes no deterioration. It will outlast the structure in which it is installed!

and... ONE STEP INSTALLATION!

No additional mechanical protection required. Safety m.i. Wiring is its own conduit. Available fittings permit installation in one operation, using standard switch and standard junction boxes. Smaller diameter provides reserve space and assures neat appearance...

and... NO VAPOR PASSAGE!

Completely filled with compacted mineral insulation. Necessity for specially installed seals in the cable-run to prevent the passage of combustible gases through a wiring system is wholly unnecessary with Safety m.i. Wiring...

and... COMPLETELY MOISTURE PROOF!

Simple fittings permanently seal both ends of each run of wiring. No possible entrance for moisture. Normal concern over this hazard is thereby completely eliminated...

and... RIGID YET FLEXIBLE!

Thumb-pressure bending, in ordinary sizes, easily fashions orderly wall patterns—conforms wiring to any contour. Once formed, and fastened with standard clamps or straps, it stays put...

and... NO HEAT DETERIORATION!

The mineral insulation is physically stable up to 2800° C., thereby assuring against deterioration by heat, even beyond the melting point (1083° C.) of the copper sheath.

Your General Cable representative is well qualified to discuss the important advantages New Safety m.i. Wiring offers to all industry—for all applications from 0-600 volts. Contact the nearest General Cable office.

GENERAL CABLE
CORPORATION

EXECUTIVE OFFICES: 420 LEXINGTON AVENUE, NEW YORK 17, NEW YORK SALES OFFICES IN PRINCIPAL CITIES OF THE UNITED STATES

"More Power to You"

Look to
LARCH
for better
POLES

produced · treated · sold by
J. Neils Lumber Company

Much of the finest transmission and telephone pole timber in the United States grows on the 200,000 acres of forest empire owned by the J. Neils Lumber Company in Western Montana. And a large percentage of this magnificent stand is Western Larch.

The larches produce straight, tall stems, the wood of which is strong, durable. Western Larch has high bending strength, high compressive strength, unusual hardness. In shock resistance, one of the most desirable characteristics in poles, Western Larch ranks the highest of the commercial softwoods.

Possessed of the qualities of long life in their original, untreated form, J. Neils literally gives Western Larch poles *double-life* through the technical processes of a modern treating plant—thus making available transmission and telephone poles of extra durability and long service.

An illustrated folder on J. Neils treated Larch poles, and information regarding their application to your requirements, will be furnished gladly on request.

Double-Life Western Larch Poles

J N *J. Neils Lumber Company*
Pole Division: LIBBY, MONTANA

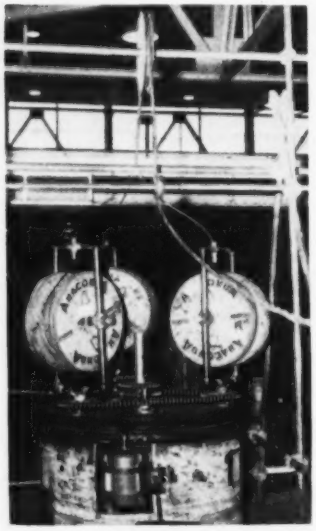
Calibrate Pressure Gauge

(*Continued from page* 187)

the possibility of leaks developing.

To apply the new method, the street ells next to the gages to be tested were drilled for ⅛-in. high-pressure fittings, as illustrated. This allows the gage to be tested in position.

On high-pressure units, gages requiring the most frequent calibration are tested in sequence. Tubing and valves indicated allow all the gages in a series, such as stage pressures, to be tested one after another and permit pressure to be applied to any gage without affecting any other. Cost of the changes necessary to calibrate by this method was small. Usually, six gages can be calibrated in the time formerly required for one.



Tailor-Made Cable Solves Shortage Problem

Two- and three-conductor aluminum service drop cable was made up by the Consolidated Edison Co. of New York because of the shortage of copper service cable. The machine was built by the company's salvage shop. Some 55,000 ft of No. 4-1/C aluminum wire was twisted into two and three wire cable. Machine was an ingenious combination of an old cable reel hub mounted on a sand blast table with a minimum of other material. Guards have been removed to show chain connected gears.

count these *extras* in...

WEAVER

cast ground rod clamps

8 Outstanding Advantages ... Competitive Prices

- Cast in our own modern foundry of electro-bronze for highest tensile strength.
- Clamps will withstand maximum tightening torque without breaking.
- Electro-bronze eliminates stretching, loosening and season cracking.
- Design assures perfect alignment of ground rod and ground wire.
- Free running threads on duronze screws efficiently convert tightening torque to high pressure contact between ground wire and rod.
- Screws furnished in either square head or socket set screw type.
- Available in "WB" series or in heavier "W" type for greater strength and longer wire bearing surface.
- Clamps have finished appearance brought about by careful grinding and water tumbling.

WEAVER PRODUCTS ARE PRODUCED COMPLETELY IN OUR OWN MODERN INTEGRATED FOUNDRY AND FACTORY FACILITIES. VISIT US WHEN YOU ARE IN ST. LOUIS.

J. A. WEAVER *Company*

2110 HOWARD ST. • ST. LOUIS 6, MO.

TELEPHONE CEntral 0881

No.6 specify HI-VOLTAGE

★ *For those higher-voltage substations . . . 115 through 161 kv . . . the Hi-Voltage Equipment Co. offers a complete line of Gang-Operated Switches.*

Substations and switching stations seldom follow any particular pattern. That is why an Air-Break Disconnect Switch Installation must be designed to fit the particular structure.

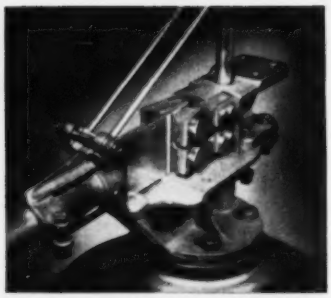
Consider that a switch installation consists not only of the switch itself, but also of an operating mechanism and bussing arrangement. The operating mechanism is standard only insofar as the individual parts are concerned . . . 1⅛" cold-rolled galvanized hexagon steel shaft, clamp-type fittings, compression couplings, connections and bearings.

The three switch designs shown on the opposite page take care of practically all switch requirements for any station PROVIDED their bases are properly sized and drilled. The dimensions we show are purely typical. They vary for practically every installation.

That is why we ask you to tell us what you want . . . to send us your station drawing, showing the preferred location of operating handles. We will work out the operating mechanism and show all attachments and drilling required in the steel.

Working with us in this way will reduce your switch installation cost as much as 20 to 40% because all parts of the switch installation are completely machined and pre-fitted at the Factory. All parts are positively identified . . . keyed to easy-to-follow installation data. Field cutting and drilling are eliminated. The simplicity and ease of installation saves hours for the construction crew.

Ask your Joslyn Representative to show you the many money saving advantages of Hi-Voltage Switches.



Typical of all Hi-Voltage, Gang-Operated Disconnect Switches are these SILVER-NICKEL CONTACTS. They combine low resistance with low friction. Stainless steel springs maintain maximum conductivity.

Powerful, compact, completely enclosed mechanism controls the swinging motion and the end motion of the Type L-W switch arm. Every part is corrosion-proof. Monel and graphite insert bearings . . . stainless steel balance spring . . . bronze gears and cranks. Nothing to stick or bind, nothing to oil and nothing to adjust.

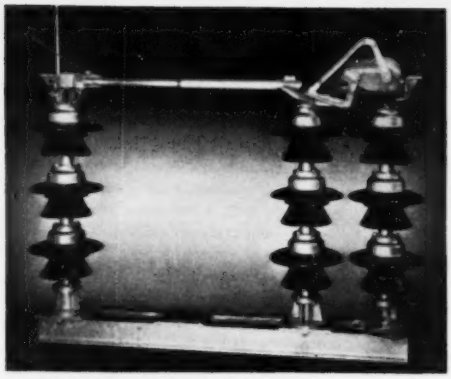
Main bearing carrying rotating insulators is a forged steel spindle mounted in monel ball bearings and stainless steel races. Never requires lubrication.

HI-VOLTAGE

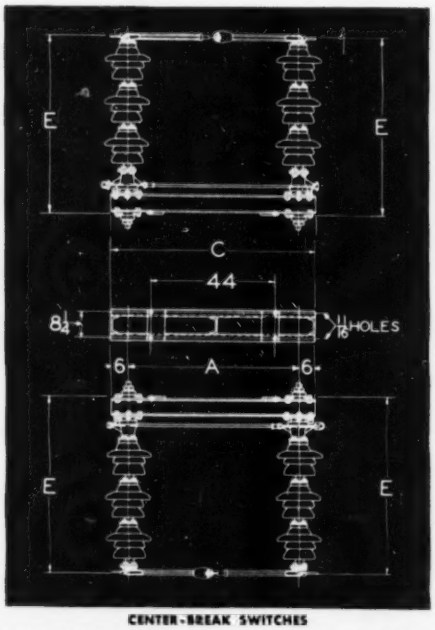
for high-voltage substations

Hi-Voltage SWITCHES ARE AVAILABLE

from 200 to 3000 Amperes, 7500 to 161,000 Volts for upright, underhung or vertical mounting.



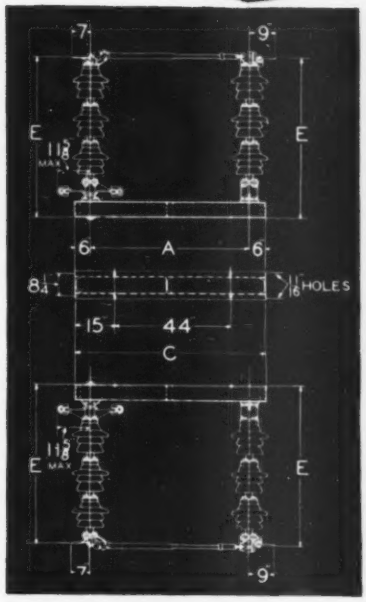
ROTATING-INSULATOR, VERTICAL-BREAK SWITCH . . . 115 and 161 kv . . . is available in two current ratings . . . 600 and 1200 amperes. Operating records of this switch under all climatic conditions, leaves little to be desired.



CENTER-BREAK SWITCHES

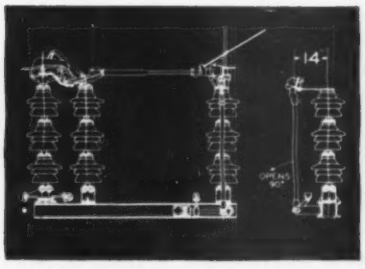
Principal applications are where phase spacing or ground clearances are limited.

Voltage	Ampere Capacity	Dimensions in Inches A	C	E	Standard Phase Spacing
115,000	600 1200	60	72	61	7′
161,000	600 1200	84	96	75½	9′



SIDE-OPENING SWITCHES

Voltage	Ampere Capacity	Dimensions in Inches A	C	E	Standard Phase Spacing
115,000	600 1200	60	72	38⅞	10′
161,000	600 1200	84	96	73⅛	14′



Type L-W Switch with Type N Grounding Switch

Grounding blade can be located on either side of switch base.

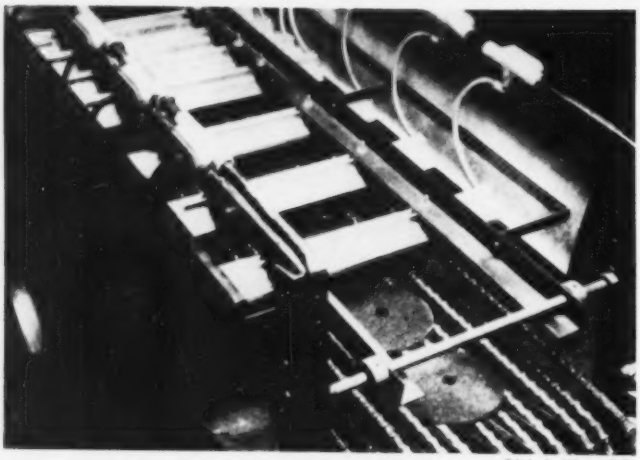
ALSO AVAILABLE!

- Grounding Switches
- Manual and Automatic Control Mechanisms
- Mechanical Interlocks
- Hi-Voltage Fuses
- Cross-arms and Mounting Frames
- And all customary accessories

EQUIPMENT COMPANY

4000 EAST 116th STREET • CLEVELAND 5, OHIO

INDUSTRIAL APPLICATIONS



Edwin L. Wiegand Co

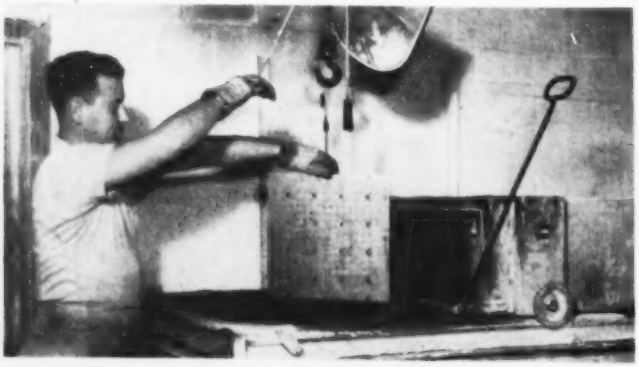
RADIANT INFRARED oven improves quality of carborundum discs, and reduces maintenance and floor space compared with former gas-fired convection oven. Heat is more uniform, safer

Infrared Cuts Carborundum Drying Costs

Infrared radiant oven dries cement on carborundum discs for the Albertson Co, Sioux City, Iowa, with increased product quality and reduced floor space and maintenance. Oven provides more uniform heat and increased safety because there is no open flame. Previously used oven was gas-fired convection type.

Oven has a bank of seven 800-w heaters in a horizontal row which operate on 230v. Problem was to find a quick safe means of drying cement used to bind carborundum grains to fiber discs.

After the abrasive grains are pressed into the cement, discs enter oven. Entering temperature is 74 F. Within few seconds it has reached 118 F. First four heaters are mounted side by side, in order to raise temperature as fast as possible, while last three heaters are placed on 8-in. centers. All heaters are held 12 in. above discs.



Electric Heating Speeds Platen Cleaning

Platen cleaning with a 30-kw salt bath electric furnace saves both time and labor at the West Co, Phoenixville, Pa. Particles of rubber adhering to platens are burned out. Job is easier, faster and cleaner than hand scrubbing. L. Albertson, Application Engineer, Philadelphia Electric Co.

Superheated Steam Cuts Paint Spraying Costs

FRED J. JOLLY, Industrial Heating Engineer, The Detroit Edison Co, Detroit

The DuPont Co has experimented with superheated steam as a substitute for compressed air in paint spraying. This method saves 50% labor, reduces overspray, uses less solvent and lowers overall painting costs. While much research and development work remain to be done, experience to date indicates that a separate source of steam, located close to the spray guns, will be best suited for this job. Due to the inflammable nature of paint spray the electric boiler with its inherent control and freedom from open flame lends itself to this hazardous location.

Based on present information it appears that there is a total potential electrical load of 14.5 kw for each spray gun, using familiar, proven electrical equipment that is already on the market. About 13 kw of this is in electric steam generating equipment and 1.5 kw of electric superheater capacity. Thermostatic control will reduce the energy requirements below the 14.5 kwhr per hour.

Tests indicate that steam at about 60 lb per sq in, about the pressure used for air spraying, is most effective. Steam should be superheated by about 40F to assure complete dryness at the gun. This makes the total temperature 347F.

Viscosity of the paint at the higher temperature is lower and therefore less solvent is required. One-bake enamels can be applied to two mil thickness with one pass. This results in labor saving of 50%. There have been no indications that the qualities of gloss, hardness, adhesion, durability or moisture resistance need be sacrificed in order to accomplish the saving in labor and material. Cost of steam is generally considered to be lower than that of compressed air.

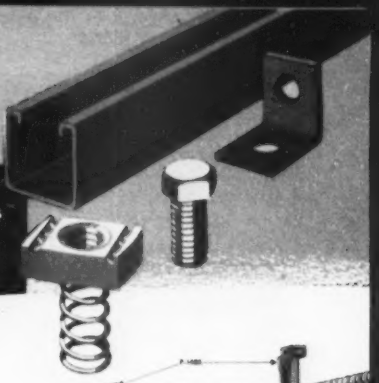
Spray guns for this process are heavier than those used with compressed air, due to insulation required for handling at high temperatures. The steam hoses are heavier than air hoses. Some additional experimental work is required for "low-solids" materials such as the vinyls and nitrocellulose lacquers.

It is understood that DuPont will

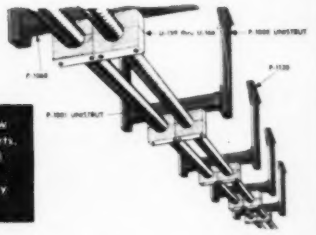
typical UNISTRUT framing applications

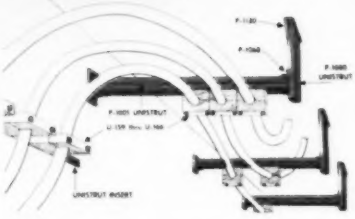
TO SUPPORT, SUSPEND AND MOUNT ALL KINDS OF ELECTRICAL EQUIPMENT

No drilling, no welding, no special tools or equipment — versatile UNISTRUT framing permits adjustments, changes or additions to be made at any time.

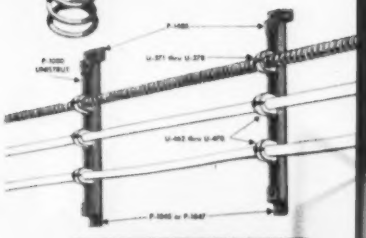


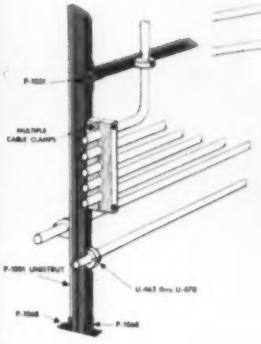
The UNISTRUT method conserves steel, reduces manpower hours, cuts overall costs.



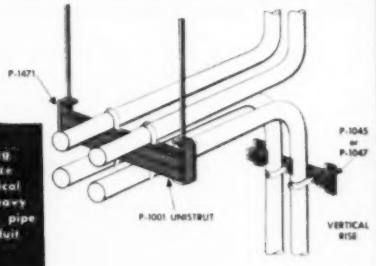


Two examples of how UNISTRUT concrete inserts, channel, fittings and maple insulating clamps support heavy overhead cable.

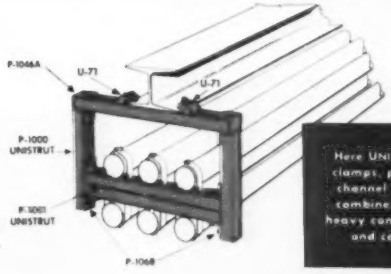




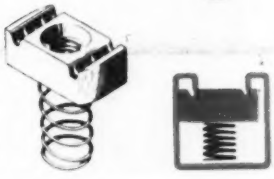
Here maple and porcelain cable clamps insulate conduit in UNISTRUT column-mounted assembly *(at left)* and cable in horizontal wall mounting *(above)*.



UNISTRUT framing assembly (trapeze hanging and vertical rise) supporting heavy conduit. Note how pipe clamps hold conduit firmly.



Here UNISTRUT beam clamps, pipe clamps, channel and fittings combine to suspend heavy conduit securely and compactly.



***Only* UNISTRUT**

offers this Spring-Held Clamping Nut which ties together both sides of the slotted channel and forms a *Box Section* at points of connection for greater load strength.

Write today for your FREE Copy

of New 78-page Catalog No. 700! Includes above drawings and countless other examples of how to mount, rack, frame, suspend and support all kinds of electrical and mechanical equipment.

UNISTRUT Products are Bonderized

For Defense Production—Every day the value of UNISTRUT products is being proved by their use in Defense Industries and Armed Services installations where flexibility, and assembly and erection speed count most.

The World's Most Flexible All-Purpose Metal Framing

UNISTRUT PRODUCTS COMPANY
1013 W. Washington Blvd.
Chicago 7, Illinois, Dept. W5

Please send without obligation the items checked below:

☐ Catalog No. 700 ☐ UNISTRUT Sample ☐ Wall Chart

Name _____

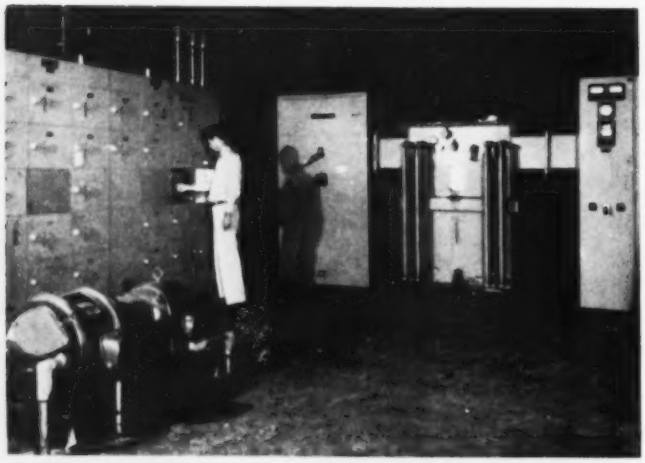
Company _____

Address _____

City _____ Zone ____ State _____

offer the process to industry on a royalty basis but users should be cautioned not to attempt to use the process without first obtaining all of the "know how" available.

Several electric boilers are available for providing saturated steam at points adjacent to the work. A superheater for each gun is also recommended for this process and an electric unit suitable for the purpose is available.



ELONGATED THROAT SECTIONS permit use of a single spare for 300, 500, 750, or 1,000-kva transformers in 10 power centers. Motor control panel is one of 35 placed throughout plant for flexibility. Frequency changer supplies trimming saws

Centers and Panels Give Flexibility

J. C. MARSHALL, Ind. App. Engr., Westinghouse Electric Corp, San Francisco

Maximum flexibility in planning plant expansion and alterations results from use of 10 power centers and 35 separate motor control centers in new California plant of Masonite Corporation. The combination permits (1) installation of new or larger capacity motor controls in existing spaces in control boards; (2) addition of full-height sections for further expansion of any existing boards; (3) a single spare transformer for 300, 500, 750, and 1,000-kva power center units.

Extra long throat sections designed for power centers permit interchangeability of four size transformers. This provides extra flexibility to meet unexpected increases of load in certain areas, and also permits use of a single 1,000-kva transformer as a common spare.

Power is delivered to plant's outdoor unit substation by serving utility at 60 kv. Two 5,000-kva three-phase transformers step it down to 2,300 v for distribution to the 10 power centers, where askarel cooled transformers step it down to 460 v for the 35 motor control centers.

Degreaser Cuts Time 60%

Degreasing parts of auto generators and starters by 6-kw electric degreaser at Franklin Products Co, Philadelphia, Pa., saves 60% of the time formerly required to wash parts by hand in chemicals, is more thorough.

INDUSTRIAL BRIEFS

Asphalt heating in portable 5-kw electric melting pot at H. H. Robertson Co, Ambridge, Pa., keeps asphalt in liquid condition so that it can be easily applied in patching asphalt-coated steel siding. Brush is used to apply asphalt to cover rivets, cracks, and to water seal overlaps of the metal. E. M. Wenner, Industrial Power Engineer, Duquesne Light Co, Pittsburgh, Pa.

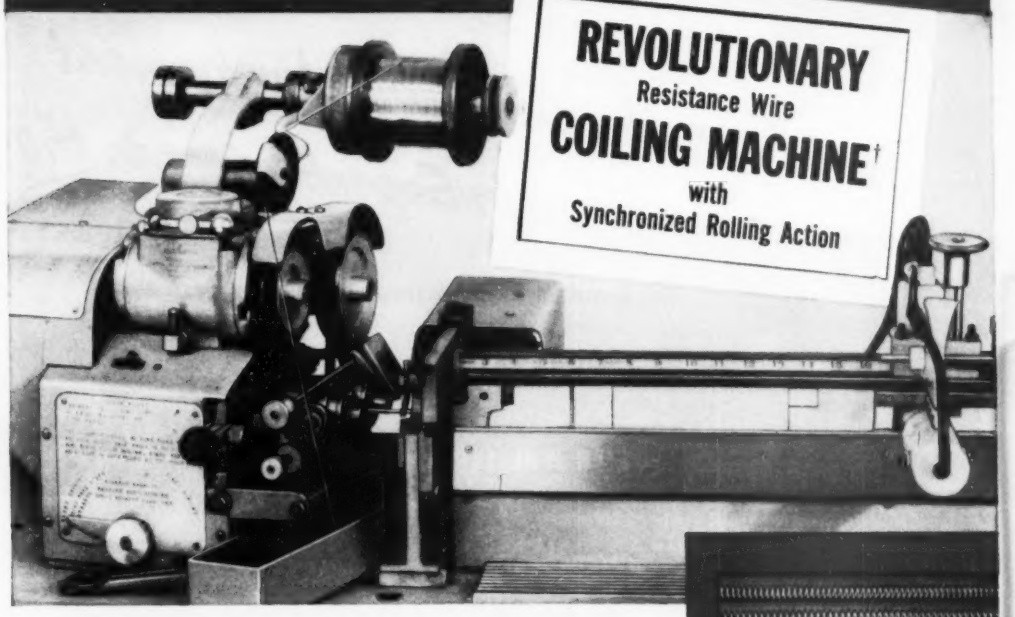
Plastic drying is improved by infrared lamp banks at the Lincoln Plastics Corp, Cambridge, Ohio, and at Jax Plastics, Byesville, Ohio. Moisture absorption is eliminated and rejects of injection molded products are minimized. Shallow pans of cellulose acetate thermoplastic pellets are kept dry under 250-w infrared lamps placed on open type wood frames arranged in tiers above each pan section to conserve space. J. G. Flint, Industrial Power Engineer, Ohio Power Co, Cambridge, O.

Air drying with a 6-kw convection-type heater in a dustproof room improved product quality at the C. A. Herr, cabinet making shop, Atglen, Pa. Heat is clean and automatic. Operating cost is less than interest on investment for a hot water system giving equal results. The previous forced air heating hystem for air drying resulted in dust accumulation on surfaces before drying. R. Smith, Industrial Power Engineer, Lancaster Div, Pennsylvania Power & Light Co.

Steam making with an electric steam boiler aids research at Victor G. Bloede Co, Baltimore, Md. It is completely automatic, convenient, and free from all fumes and noise. This low cost installation is used to supply heat for cooking, distilling, and other processes used in developing new types of industrial starch adhesives. Piping costs and heat losses were reduced by placing boiler in out-of-the-way corner of laboratory, near point of use. Formerly, steam was used from a central heating plant and the laboratory working hours were restricted to times when it was operating. Owners report two years of completely trouble-free service. G. H. Hoffman, Industrial Power Dept Consolidated Gas, Electric Light & Power Co of Baltimore.

DRIVER-HARRIS ANNOUNCES . . .

REVOLUTIONARY
Resistance Wire
COILING MACHINE†
with
Synchronized Rolling Action



As producers of the world famous "Nichrome"* and other outstanding electric heating and resistance alloys, Driver-Harris engineers are interested in obtaining application results commensurate with the exceptional advantages their alloys afford. Therefore they have developed a new coiling machine which eliminates wire coiling faults—especially coil irregularity due to work-hardened areas produced during coil formation.

This new machine is the result of knowledge accumulated during forty years of close association with wire coiling problems. Its revolutionary principle of operation—*the synchronized rolling action of all coiling parts*—results in vastly improved performance over that of any other type machine.

Product of long study and a thorough knowledge of the requirements of the industry, this Driver-Harris unit—

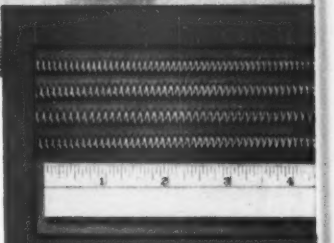
(1) handles the full range of resistance wire coiling normally required, close or open winding (and can be adapted for twin wire coiling);

(2) cuts coil ends clean on all sizes, close or open wound;

(3) maintains resistance accuracy of cut coils at all times by photo-electric control (variation not exceeding ± 1%);

(4) affords the lowest operational and maintenance costs of any comparable coiling machine.

Standard Model coils #20 to #36 B&S gauge wire. Units for other gauges built to order. Send for illustrated Bulletin C-52, giving full information.



Note even spacing between turns of stretched coils.

Coil ends lie *flat*. No burring or twisting of wire.

*T.M. Reg. U.S. Pat. Off.
†Patent Pending

Driver-Harris Company
HARRISON, NEW JERSEY
BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco

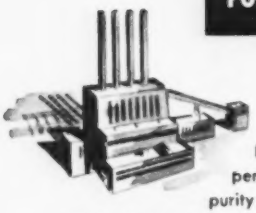
MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD

From the pioneering development in Superheaters to the

the trend in modern steam generator design

places the spotlight on . . .

FOSTER WHEELER combination radiant and convection



Today's central station calls for larger unit sizes of turbines and boilers—higher steam pressures and temperatures—and optimum quality and performance. To provide steam in the quantity, pressure, temperature and purity demanded, increased emphasis falls upon the design and function of superheaters and reheaters. Their integration with other components of equipment and plant requires the high degree of skill and experience that comes only with years of leadership in the field.

Foster Wheeler's pioneering effort in steam generator design, as reflected in the following record of achievement, has led the way for every major development in the reheat cycle.

1902 — Superheated steam introduced commercially in the United States.

1904 — Convection superheaters standardized with cast iron extended surface rings applied to steel tubes. Bare tubes were later used with improved design technique and improved metal selection.

1919 — Radiant superheaters developed after long research and experimentation.

1924 — Water walls and water backs applied to many types of furnaces burning various fuels.

1926 — Radiant reheaters and radiant superheaters installed in one of the first large high pressure reheat units in the country.

1946 — First large steam generator installed in a central station to operate over a wide load range at 1000 F final steam temperature.

As a result of this 50 years' background of experience and leadership, each new steam generator can be depended upon to have Foster Wheeler's integrated quality and performance.

FOSTER WHEELER CORPORATION • 165 BROADWAY • NEW YORK

complete reheat cycle

superheaters and convection reheaters

One million lb steam per hr 1525 psig 1005 F/1005 F is the rated capacity of this unit now under construction for a large eastern central station.

6, NEW YORK

FOSTER WHEELER

"AIR COMES OUT HERE." AEPCo rural representative explains hay drier operation

Tell 'Em, Show 'Em Sells Driers

R. J. BLAIR, Appalachian Electric Power Co, Pulaski, Va.

Mass selling works in the case of hay driers as well as most everything else. A fine example of this is the meeting that was staged last February by Appalachian Electric Power Co's rural sales department in Hobart N. Grubb's store in Wytheville, Va.

Right at the meeting three driers were sold. An estimated 150 immediate prospects were lined up from the 220 in attendance who came as the result of mailing 500 invitations. There were 30 others who wanted to come, but could not and took the trouble to write letters telling why.

The Grubb store has been a successful merchandiser of hay drying equipment since 1940. A complete stock of parts and supplies is carried. The store floor was cleared and seats arranged. At the front a full-size fan house with 36-in. fan, motor and starting equipment was set up and a hay hoist put on top of it. The program included a film, "Sure Cure for the Weather," and a series of talks on drier benefits, installation and operation, on drier components—fans, motors, controls and switches, V-belt drives—and on hay hoisting and handling equipment.

At noon a fast buffet lunch (20 minutes) was served by AEPCo home economists while guests looked over the drier equipment on display. Then came a tour of three farms where nine driers of different sizes and types were inspected. The amount of pre-buying education accomplished at this one meeting would have required years of work in individual calls.

Sells "Living with Light" to 70% of Prospect Schools

PAUL H. HILDEBRAND, Pennsylvania Power & Light Co, Allentown, Pa.

How would you like to tell a group of technical men, with only limited sales experience, to sell a more or less intangible product that promises no immediate return, to customers with severely limited budgets who must account for every dollar they spend?

And, have 70 percent of all their contacts result in sales!

Well, that's just what happened last year, in Pennsylvania Power & Light Co's territory.

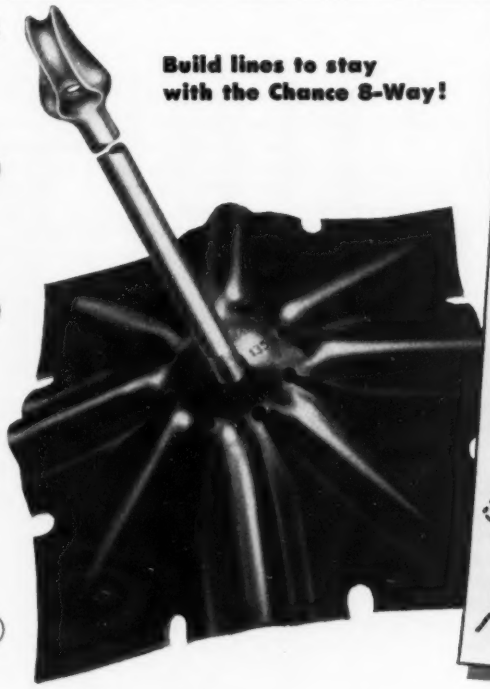
LIGHTING CONSULTANT Howard Kreitzberger explains the "Living with Light" program to George L. Feissner, supervising principal of Freeland, Pa., schools

The technical men are the company's lighting consultants, engineers who work out the solutions to difficult lighting problems encountered by field commercial and industrial salesmen and who help in directing lighting promotions in all lighting markets.

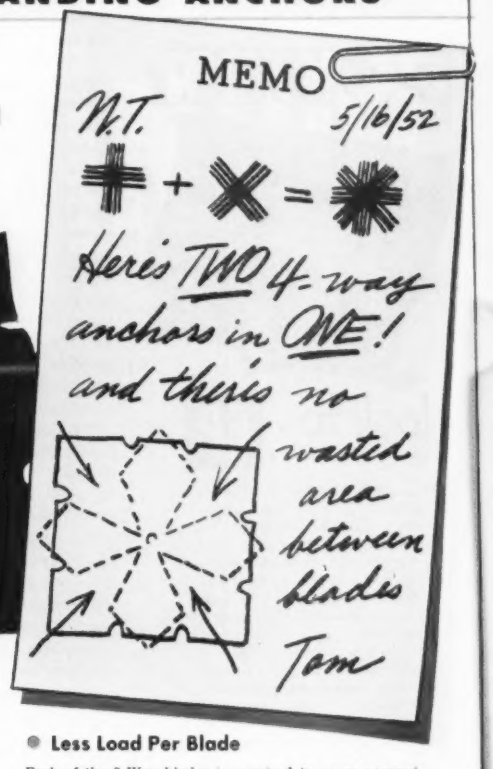
The product is the Better Light-Better Sight Bureau's program for teaching about light and sight in junior high schools, called "Living with Light."

The prospects were 245 school districts in the service area with grade levels for which this teaching program is designed. Of them, 231 were contacted and 161 ordered the teaching

CHANCE 8-WAY EXPANDING ANCHORS



Build lines to stay with the Chance 8-Way!



No Wasted Space Between Blades

In designing the 8-Way, steel, expanding anchor, A. B. Chance Company engineers took full advantage of all the available area. There is no wasted space between blades. The load is distributed all the way around the anchor.

Expands in Cone Shape

Controlled by the bell shaped base, the eight blade, one piece top plate expands to form a cone shaped square, which distributes the anchor's holding power over a wide area, building up compression against an inverted pyramid of earth. The 8-Way retains its shape under extremely heavy loads because the base plate supports the blades in the middle and distributes the load uniformly over the blades. Reinforcing ribs provide additional strength.

Less Load Per Blade

Each of the 8-Way blades is required to carry approximately one-eighth of the total load, whereas each blade of the conventional four or two-way expanding anchor has to support from two to four times this amount. This is particularly advantageous where heavy obstructions block expansion of one or two blades. The other blades can expand to carry the load.

More Holding Power for Less

The Chance 8-Way Expanding Anchor saves you money. The simplified design cuts manufacturing costs—a saving passed along to 8-Way customers. Compare costs per square inch area—you get more holding power for less with the Chance 8-Way Expanding Anchor.

Cat No.	Hole Size	Area Sq. In.	Nominal Class	Rod Size (Order Separately)	Approx. Weight Per 100	No. in Bundle	Ultimate Soil-Anchor Holding Strength—Pounds 7' Depth. No Safety Factors Included.				
							*Class 3	*Class 4	*Class 5	*Class 6	*Class 7
6870	6"	70	2200, 4000 6000	½"x6' ⅝"x7' ⅝" x 8'	467	5	16000	14000	11000	8500	5000
88100	8"	100	6000	⅝" x 7' ¾" x 8'	811	3	22000	18500	15000	13000	8000
88115	8"	115	8000		880	3	24500	20500	17000	14000	9000
88135	8"	135	10000, 12000		1056	3	26500	22000	18500	15000	10000
88135-1	8"	135	10000, 12000	1" x 10'	1056	3	26500	22000	18500	15000	10000
1082	10"	290	20000		1900	2	31000	26500	21000	16500	12000

* These numbers indicate types of soil: 3. Hard, dry—hardpan. 4. Crumbly, damp—usually clay predominates. 5. Firm, moist—usually clay predominates. Includes most well drained areas. 6. Plastic, wet—usually clay predominates. Includes areas only seasonally wet with slow drain as in fairly flat terrain. 7. Loose, dry—arid regions with sand or gravel predominating. Also loose wet—high in sand, gravel or loam content—absorbs excessive moisture in rainy seasons as in poorly drained areas.

C52-12

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Since 1909, the job of The Electric Products Company has been to create and develop special electrical rotating equipment . . . motors and generators to do existing jobs better or to reach *into* new fields to do jobs that couldn't be done before. The natural "by-product" of our more than 40 years of specialization is that you get equipment designed and built to the exact requirements of your application . . . equipment that has greater dependability, longer life and that requires less maintenance.

Send in the coupon below for detailed information about our Custom-Engineered synchronous motors and generators . . . d-c motors and generators . . . induction motors . . . battery chargers . . . frequency changers.

A nation-wide sales engineering and service organization stands ready to meet all User requirements.

THE ELECTRIC
PRODUCTS COMPANY

1731 CLARKSTONE ROAD
CLEVELAND 12, OHIO

Attach coupon to your letterhead for your copy of Bulletin 2-200

NAME_____
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STREET_____
CITY_____ ZONE____ STATE_____
X-76

program, each paying for the material from school district funds.

We have a total of 11 lighting consultants on the staffs of our six division commercial managers. A brief training session was planned to orient them on the teaching program. We took them through the film strips, study leaflets, teacher's guidebook and other material included in the program.

After consideration, we decided that the schools would be asked to buy the teaching materials with their own funds. It was fully realized that this would not make the work of the consultants easier, because of the large number of small rural schools operating under severe financial limitations. We realized, too, that compared with the time and effort to be spent in promoting the program, the extra costs of the teaching aids was a comparatively minor item.

Our decision was based upon the simple fact that a handout may or may not be used but an investment of one's own funds is a different story. We felt that even though this policy might increase the difficulty of promotion, the school administrator receiving his "Living with Light" teaching aids would realize that these materials represented a share of his budget and would be more eager to see them used.

As a courtesy gesture, the materials were ordered by the company. Each consultant periodically compiled the needs of the schools in his division and forwarded the totals to our purchasing department. The materials were shipped to the division offices and parceled out to the schools. The Bureau billed the company and we in turn billed the schools for the cost of the materials.

Based on this plan, the consultants set to work. Individual contacts were made with the school administrators concerned, usually the county superintendent or in the case of parochial schools, the ecclesiastical head of the parish. After the approval of these authorities had been secured, the consultants called on the principals of the individual schools. Meetings were then arranged with the teachers who would be responsible for the instruction, and the materials and methods reviewed with them.

The activity was started in the spring of 1951. By February 1, 1952, 231 of the 245 school districts had been contacted and 161 of them had ordered 172 classroom packages, each with sufficient materials for the instruction of 40 students; 34 were holding off decision; 36 had refused to buy. Many of the 36 declining the program, did so because funds were not available for even the modest expenditure required. No school refused on the ground of any fault in the program.

Adequate Wiring Goes on Television

Dramatizing the necessity for adequate wiring, F. L. Rimbach, director of agricultural development, New England Electric System, (left) demonstrates what happens on overloaded circuits on a television show during a recent Farm Safety Week. At right is Malcolm McCormick who represented the farmer's viewpoint in the show.

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Increasing use of aluminum conductor distribution systems has naturally raised many questions concerning connections . . . connections for aluminum to copper and aluminum to aluminum . . . cold flow . . . oxidation . . . corrosion . . . questions that Burndy is prepared to answer for you immediately.

With a 10-year background of aluminum research, development and field testing, Burndy engineers are ready with the right answers and the right connectors to meet all your application requirements.

For quick practical help in solving your aluminum problems, contact Burndy. Remember: connectors for aluminum are no problem to Burndy.

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Norwalk, Connect.

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NOT ONE FAILURE in over 20 years

Laytex-Neoprene Supervisory Control Cables

There has never been a reported failure of Laytex-insulated control cable in its 20 years of manufacture. The insulation resistance of these cables actually improves in wet locations! The small diameter of Laytex makes unnecessary the enlargement of cable ducts where signal service is expanding. The neoprene jacket provides exceptional resistance to abrasion and other abuse, and is highly resistant to the action of oil, flame, and sunlight. The cables are light in weight, easy to install.

There is U. S. Control Wiring for every type of control, supervisory or metering problem. They are unexcelled in electrical qualities; dielectric strength and tensile strength are extremely high; low water absorption, high aging and moisture-resistant qualities. For more information write to address below.

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U.S.RUBBER
SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

ELECTRICAL WIRE AND CABLE DEPARTMENT • 1230 AVENUE OF THE AMERICAS, NEW YORK 20, NEW YORK

Two-Lamp Fluorescent Circline Fixture

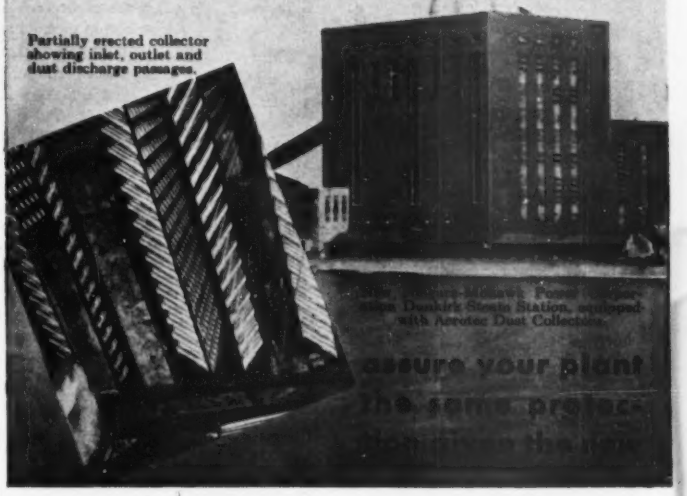
Designed for residential applications in kitchens, bedrooms, bathrooms, hallways and pantries, as well as for commercial applications such as waiting rooms and small offices, a new two-lamp Circline fluorescent lighting fixture has been announced by the Lighting Division of Sylvania Electric Products Inc. The new fixture has one 8-inch, 22-w pre-heat type standard-start lamp mounted inside a 12-inch, 32-w instant-start lamp. Elongated slots in the chassis are spaced to fit standard outlet boxes so the unit is easily attached with mounting screws.

In and Out and Portable

To change from drawing fresh air in to pulling stale air out, just turn the fan around in the window spacer panel. Or the fan can be removed from the window and used anywhere in the house. Spacer is adjustable to window width, 30½ to 39 inches. Fan moves 2,500 cu ft of air per minute at high speed, has two lower speeds. Maker is the Lau Blower Co, Dayton 7, Ohio.

high efficiency AEROTEC

DUST COLLECTORS



Partially erected collector showing inlet, outlet and dust discharge passages.

NIAGARA MOHAWK POWER CORPORATION

Dunkirk Station . . . and a duplicate Albany Plant

At the new Dunkirk Steam Station of Niagara Mohawk Power Corporation, two reheat steam generators of 670,000 lb. per hour capacity are pulverized fuel-fired. Dust collection for this station is handled by Aerotec, Design 3 RAS Collectors, and a duplicate system is under construction for the new Albany Steam Plant . . . making a total of eleven Niagara-Mohawk boilers to be equipped with Aerotec Dust Collectors.

The collectors for Dunkirk and Albany consist of 84 "Unit Building Block" elements completely assembled at the factory for easy erection in the field. The small diameter tubes, of permanent molded aluminum construction, have proved their extremely high collection efficiency and long life on hundreds of installations. Their light weight cuts steel requirements for supporting structure, and makes possible roof installations with a minimum of reinforcement. The light weight tubes also reduce erection costs.

Aerotec efficiencies meet or exceed the requirements of most dust ordinances today. Evenly spaced tube outlets provide excellent inlet flow conditions for an AEROTEC electrical secondary—should future ordinances require still higher efficiencies.

Write for the new Design 3 RAS Catalog No. 601.

Project and Sales Engineers

THE THERMIX CORPORATION

GREENWICH, CONNECTICUT

(Offices in 38 Principal Cities)

Canadian Affiliates: T. C. CHOWN, LTD.
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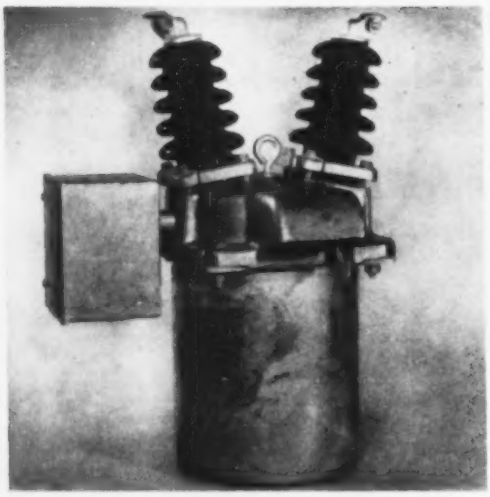
THE AEROTEC CORPORATION

GREENWICH, CONNECTICUT

Manufacturers of mechanical dust collectors, electrical precipitators, air cleaners, industrial integral dust collectors, gas-oil scrubbers and dust reclaiming equipment.

NEW EQUIPMENT



Load Pickup Sectionalizer

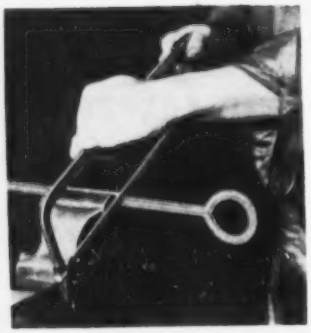
A load pickup sectionalizer, type LPS, is now available and can be used in conjunction with reclosing circuit breakers or reclosers. The LPS sectionalizer enables distribution circuits to be picked up after long power outages without the manual operations that are normally required by this operation.

The unit is said to automatically compensate for the power demand that accumulates during an outage. If the accumulation is enough to cause the reclosing circuit breakers to operate, the sectionalizer will temporarily disconnect part of the load. The load is reconnected by a predetermined time delay, self-contained time relay.

Under fault conditions the sectionalizer operates as a conventional automatic line sectionalizer. It can also serve as a manual load-break switch.

The unit is contained in a galvanized steel tank with a cast-iron cover casting that supports 15-kv line bushings. The series coils can be had in ratings from 5 to 100 amp. Control relay voltage can be either 110 or 220 v ac.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.



Threaded Steel Rod

Known as Redi-bolt, this threaded steel rod is applicable to many repair, installation and construction jobs. It comes in straight 36-in. lengths and in six diameters from ¼ in. to ¾ in.

Long straight bolts and adjusting rods can be made easily by hacksawing bolt to size. Heat from a blowtorch is enough to bend bolts into U-bolts, L-bolts, Eye-bolts, etc.

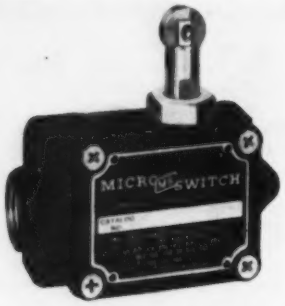
Redi-bolts are applicable to hanging electrical conduit and bus ducts.

Redi-bolt, P. O. Box 6102, Chicago, Ill.

Snap Action Switch

A snap action switch designed for high-precision performance in rugged, cam actuated service has been developed recently by the company.

The new design has a roller plunger actuator adapted to operation by cams with a rise of up to 30 degrees. The die cast aluminum enclosure is designed to protect the basic switch



against damage from vibration and shock and the cover is sealed against dust, dirt, oil and moisture.

Switches are rated to make or break steady state currents of 20 amp and to handle inrush up to 75 amp.

Micro Switch, Freeport, Ill.

Floor Conductivity Tester

A push-button operated instrument, designated as Vibrotest Model 267, has been developed to test the electrical resistance of conductive flooring in accordance with the N.F.P.A.

It is used to test conductive floors where static charges or stray electric

potentials may cause explosions in hazardous atmospheres or materials. It was originally developed for testing circuit stresses up to 25,000 amp. the conductivity of hospital floors.

It has ranges of 0-20 megohms at 125-v dc test potential and 0-200 megohms at 500-v dc. Instrument is is housed in a steel case measuring 12 by 9 by 10 in.

Associated Research, Inc, 3760 W. Belmont Ave, Chicago 18, Ill.

Insulation Tester

A new 1500-v insulation tester is said to have been developed to meet the requirements of safety, instantaneous indication, direct reading in

(*Continued on page* 210)

JOHN LINEMAN SAYS:

For Secondary Service

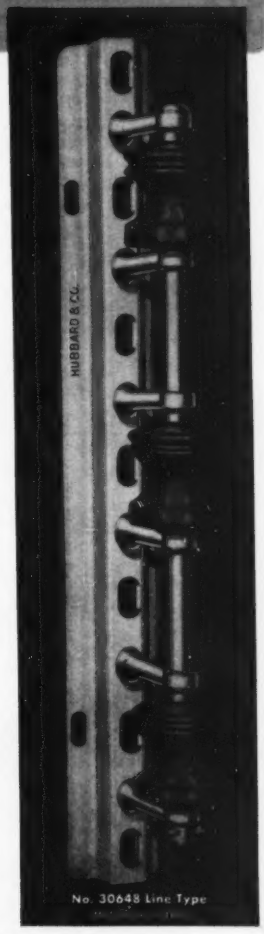
HUB-RAKS COME FIRST

"Gosh, right through the center of every hole."

"I thought I was husky, but I'm not in it with the HUB-RAK."

"For back-to-back mounting, bolts do double duty."

"If there's a place to hang it, there's a hole to match."



HUB-RAKS are furnished for 1 to 4 line wires with conductor spacings from 4 to 12 inches.

"Points strong as an ox . . . smoothly rounded too."

"Highest grade porcelain insulators, smooth surfaces, sure easy on conductors."

"Installation or replacement . . . it's dead easy with the HUB-RAK."

"It sure is the finest rack ever made."

HUBBARD AND COMPANY

ESTABLISHED 1843

PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA

"Hang the Load on Hubbard Hardware!"

Here's Proof of

3029 Pressure-Creosoted Poles set on New Haven's right-of-way in 1918— 98.7% still in service after 34 years

● In 1918, the New York, New Haven & Hartford Railroad set 3029 yellow pine poles—pressure-treated with Creosote Oil—to carry a communications cable line along its right-of-way in New York and Connecticut. Today, 34 years later, only 41 of these poles have been removed for failure. The other 98.7% are still in service.

The poles have undergone five inspections to date; another is scheduled next year. Each inspection consists of careful visual examination, thorough soundings and test borings where necessary.

The first inspection, in 1933, showed four poles had been removed. By 1941, 10 additional poles were gone; by 1945, four more; by 1948, 12 more, and in 1951, 11 more replacements had been made.

All poles on the line are yellow pine, subjected to the "full-cell" treating process (A. T. & T. specification L-3239) with 12-pound retention.

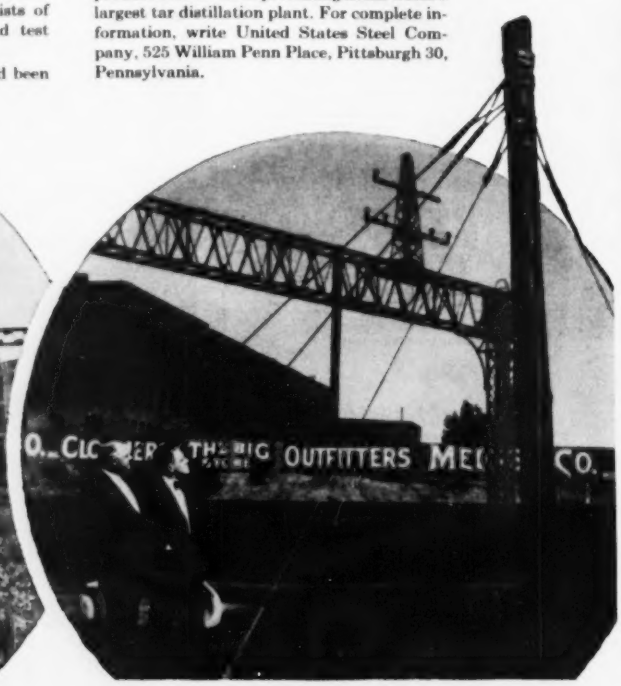
J. D. Rogers, the New Haven's Superintendent of Communications, says, "We have found that a pole treated with the 'full-cell' process can be expected to stand up without replacement for 25 to 35 years, and possibly for a longer period than that."

Records like these are your best guide when you choose a wood preservative. They are real *proof of performance*. They are the main reason the wood preserving industry used more than 200 million gallons of Creosote Oil preservatives in 1950.

Creosote Oil contains not one, but many compounds whose toxicity and permanence ward off attack by such wood destroyers as termites, fungi, dry rot and marine borers.

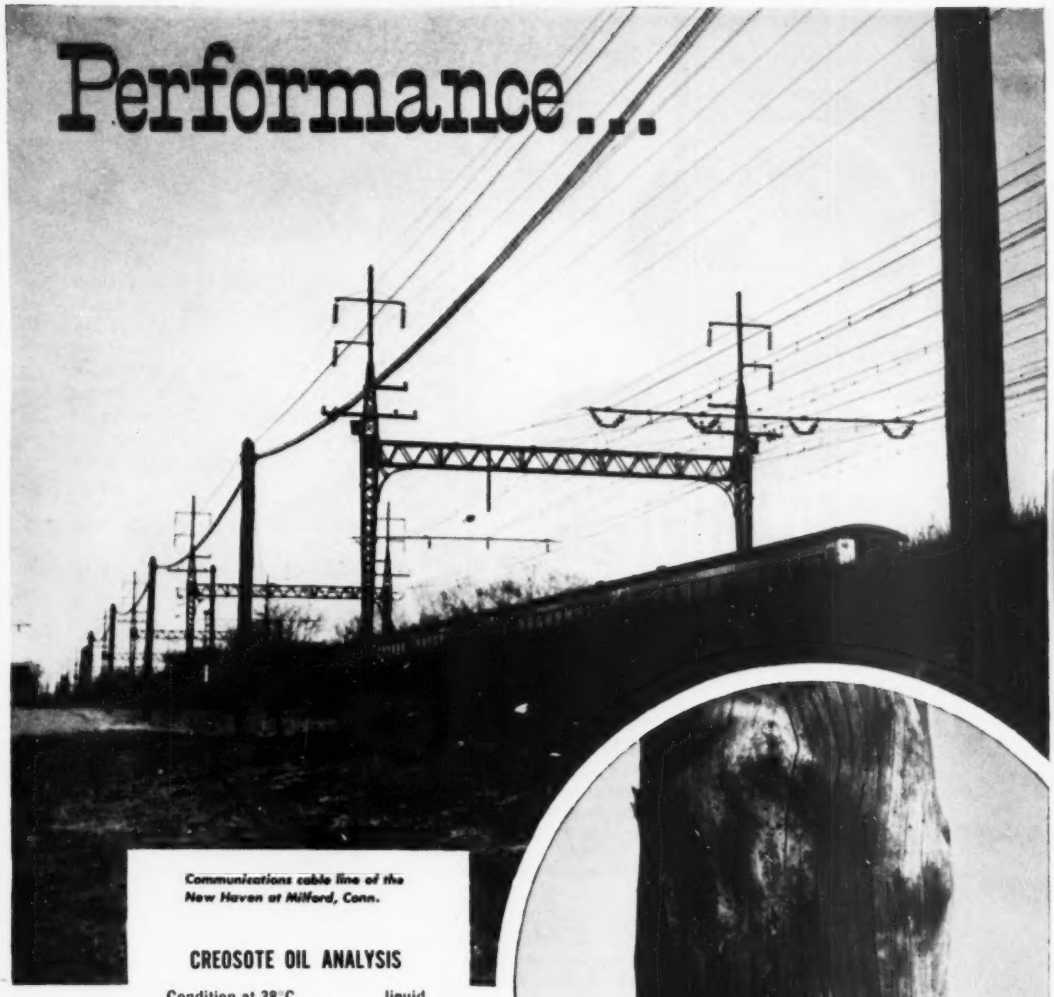
For a uniform product that gives you uniformly good performance, specify U·S·S Creosote Oil. It's the product of *continuous* processing in the world's largest tar distillation plant. For complete information, write United States Steel Company, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

View of the line at West Haven, Conn.



1918 photo shows first of the 3029 poles on the line at West River.

Performance...



Communications cable line of the New Haven at Milford, Conn.

CREOSOTE OIL ANALYSIS

Condition at 38°C.	liquid
Spec. gravity at 38°C.	1.059
Dist. below 200	.842%
Dist. below 210	1.34%
Dist. below 235	14.20%
Residue above 355	25.75%
Water	2.16%
Tarry and suspended	.70%

Close-up of a pole near the East Woodmont Tower.

U·S·S CREOSOTE OIL

USS

UNITED STATES STEEL

leading photoelectric control

FOR STREET LIGHTING

The F-P Series 63300B Control is the latest unit in a proven line of photoelectric controls for street lighting that have been operating successfully on lighting circuits for over seven years. Today there are more than 35,000 F-P Controls in use by over 700 utilities.

Fisher-Pierce has maintained leadership in photoelectric street lighting control through:

PERFORMANCE — F-P Controls provide street lighting safety because lights are on *when needed*, regardless of time of day. Because the control is photoelectric, it depends only on natural light values for operation. There is no mechanical device to get out of phase with actual daylight conditions.

ENGINEERING — The F-P Series 63300B circuit and technical operating features are the result of years of field experience. The development work and testing was performed in conjunction with utility engineers. The Fisher-Pierce organization is in a position to help utilities in planning, installing and maintaining control systems.

ECONOMY — F-P Controls provide true economy: purchase price and cost of installation are low. Maintenance is practically negligible as compared to other control methods. To give you a picture of this F-P economy, we will be glad to refer you to some of our customers who have had extensive field experience with these controls.

Write for Bulletin 63300B.

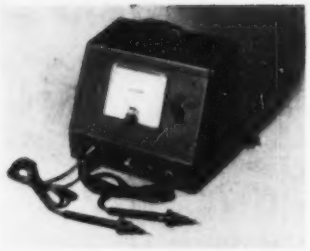
FP

The FISHER-PIERCE CO., Inc.

82 Pearl St., So. Braintree, Boston 85, Mass.

EXPORT: PHILIPS EXPORT CORP. 100 E. 42nd STREET NEW YORK 17, N.Y.

IN CANADA: NORTHERN ELECTRIC CO., Ltd.

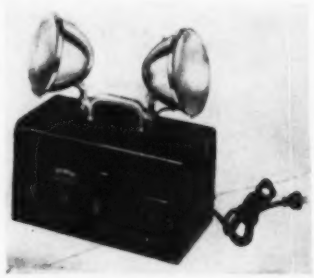


megohms, and ability to discriminate between complete insulation breakdown and leakage through insulation.

In case an operator should get across the test leads, it is reported that the dead short current is limited to a maximum of 100 microamps. A current of this magnitude usually cannot be felt if the test probes are firmly held.

The insulation tester is housed in a sloping front cabinet and the total weight of the set is 14-lbs.

Eastern Specialty Co, 3617 N. 8 St, Philadelphia, Pa.



Emergency Light

This automatic emergency light is reportedly charged to capacity at all times by an enclosed automatic trickle charger. The floodlight is said to provide instant automatic floodlighting for at least 4 hrs in the event of regular lighting power failures.

In addition to the trickle charger, the unit has a fast charger which fully recharges the battery within 10 hrs after emergency use.

U-C Lite Mfg Co, 1050 W. Hubbard St, Chicago 22, Ill.

Isolating Transformers

The Acme shielded-isolating transformer reportedly provides a voltage supply source independent of any line

(*Continued on page* 214)

Type HD, single phase, 60 cycle oil-filled distribution transformer, 333 KVA, 12470-2400/4160Y volts.

333 KVA

TWO NEW Type HD UPTEGRAFF DISTRIBUTION TRANSFORMERS

Shown here are two new Uptegraff Distribution Transformers. Both are oil-immersed units for outdoor installation.

Core and coil assemblies are designed for even distribution of potentials by avoiding points of high dielectric stress. They are thoroughly dried and impregnated while warm. Radiators are readily accessible for cleaning and painting. Tanks are of heavy gauge, shot-blasted steel covered with three coats of paint specially selected for the lasting protection it affords. Tank bottoms are undercoated.

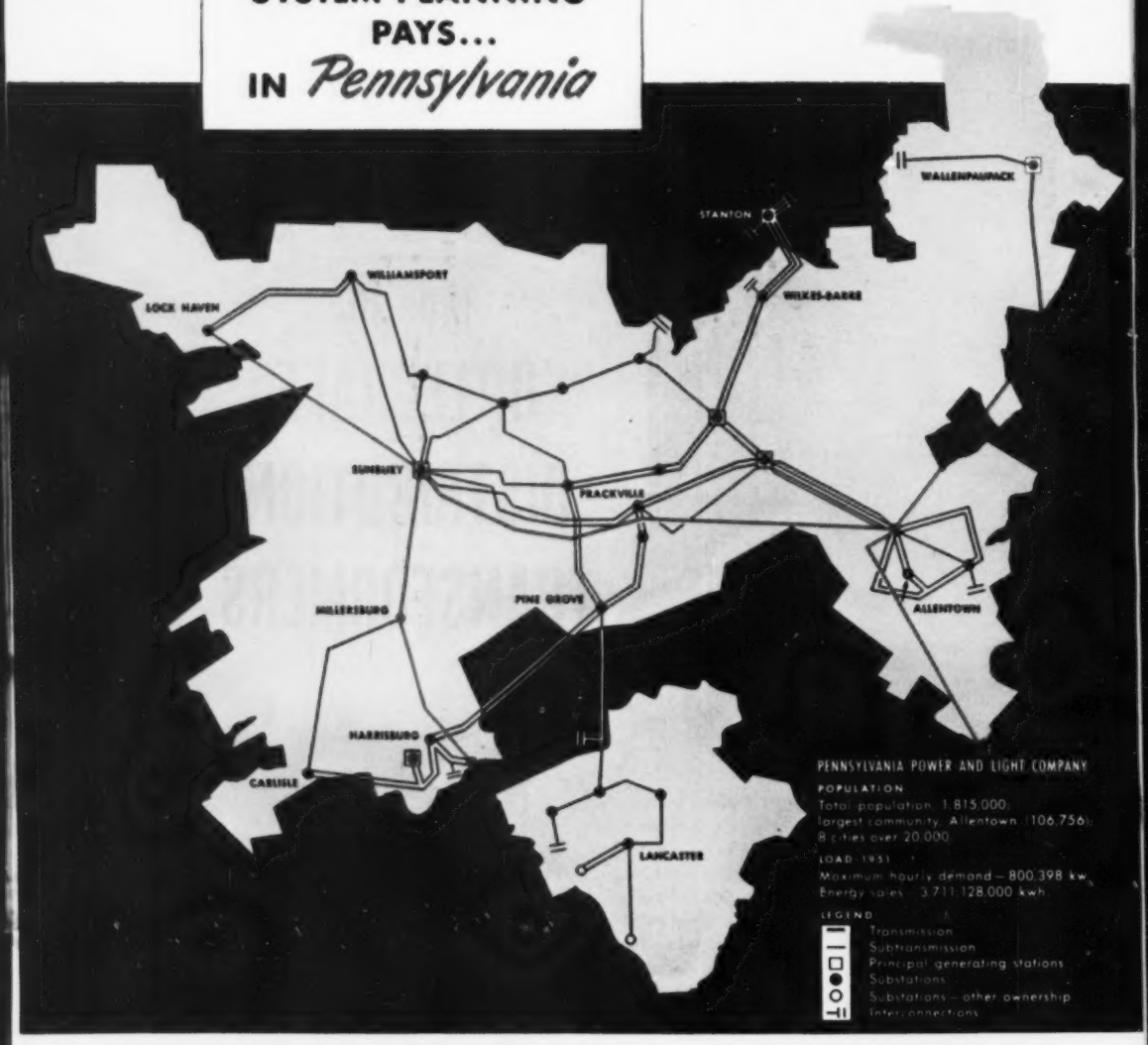
The complete Uptegraff line includes transformers for all classes of service, from the smallest specialty transformers to 10,000 KVA Power Units, including dry and liquid-filled types for indoor and outdoor service. We can quickly meet your needs with transformers built to your specifications.

150 KVA

150 KVA type HD single phase, 60 cycle oil-filled unit 2400/4160Y-120/240 volts.

R · E · UPTEGRAFF MANUFACTURING CO. SCOTTDALE PENNSYLVANIA

SYSTEM PLANNING PAYS... IN *Pennsylvania*



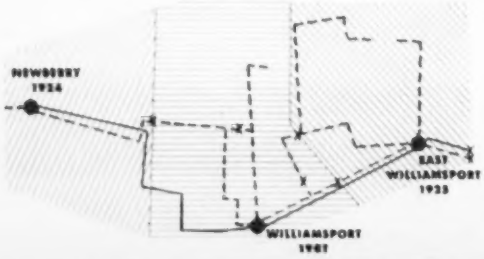
HOW THEY MET LOAD GROWTH AT WILLIAMSPORT...

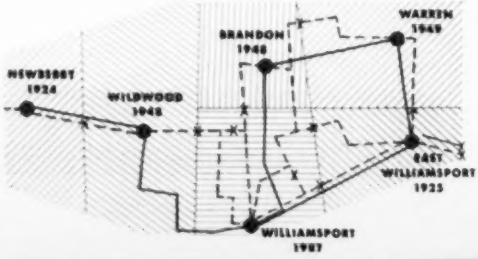
In 1907, Williamsport had a load of 400 kw, with only one substation required. By 1925, the load had increased to 5000 kw, resulting in additions of substations in both the eastern and western parts of the area.

LEGEND

- 12-kv lines
- 4-kv lines
- Area of load responsibility
- Substation and year established
- Normal sectionalizing

Since 1925, the load has increased to 14,000 kw in 1951, and three more substations added. The lines feeding into Williamsport provide the reliability and capacity to expand the distribution system as the load grows.





Small power blocks ...long-range solution

Pennsylvania Power and Light Company can judge accurately the results of their system planning. Today this careful, long-range planning is reflected in their ability to supply more load . . . to grow easily and economically . . . to provide new high levels of service continuity. Small units of "load responsibility" are the cornerstone of this system, permitting them to take full advantage of modern *unitized* substations. The success of their long-range simplified system planning is measured by the practical yardstick of "economic workability".

ROSELAND

How they built their system . . . Definite "load responsibility" such as 1500-2000 kva for 4 kv, and 3000-10,000 kva for 12 kv, is assigned to each block. As the load grows, additional blocks of load responsibility are supplied from a carefully planned 66-kv subtransmission system, covering their 9500 square miles of area served. This simplified network, in conjunction with an overlying high-voltage transmission system, permits picking up blocks of load or introducing power supply where required, and enables Pennsylvania Power and Light Company to utilize the inherent flexibility and reliability of modern unitized substations.

Meeting the growth is the payoff . . . While easily and economically meeting load-growth problems like that at Williamsport, the Pennsylvania Power and Light Company have carried on a tremendous expansion program, adding capacity throughout the system. With changes in electrical demands, it won't be necessary to change their "plan" . . . they'll simply accelerate it or slow it down, as the situation requires. Because of the economy and effectiveness of such planning, this progressive utility has every reason to face new peak loads confidently . . . they're ready to grow and grow!

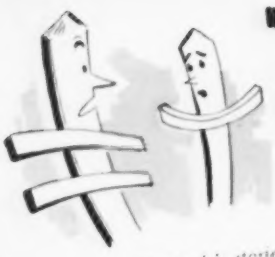
Westinghouse modern unitized equipment, when installed as an integral part of such a long-range plan, can contribute to the ease, dependability, and economy of your operation. A completely staffed System Planning Service is ready to assist you. Call your nearby Westinghouse Office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-97160

You can be sure... if it's Westinghouse

WESTINGHOUSE

SYSTEM PLANNING SERVICE



"The termites got your Uncle Knott..."

(*Cissie Cleanpole's stories of the grim days B.P.**)

"Yes, dear, he really was a fine tree in his day . . . and a fine pole, too, before he got bugs in his sapwood. But your Uncle Knott fell in with bad companions . . . termites.

"He used to insist that he could take them or leave them. But the time came when he couldn't. Then one night he simply keeled over in a high wind, and that was the end of poor Knotty. But you mustn't think too harshly of him. That was before the days of PENTA Preservative . . . "

**B.P.—Before PENTA*

PENTA gives clean, positive, protection

Poor Uncle Knott could have been saved by early use of PENTA Preservative, the clean chemical formula that's so easy on the men who climb the poles.

For the powerful, laboratory-controlled properties of PENTAchlorophenol are as effective as they are uniform. This modern preservative penetrates deeply, won't leach out, assures long years of life and minimum maintenance costs.

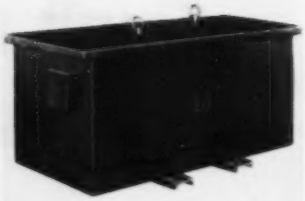
PENTA-treated poles are guarded scientifically from shell rot, top rot, ground line decay and insect damage. Yet PENTA'S clean protection for your poles costs no more than other types of wood preservation.

CHAPMAN CHEMICAL COMPANY
333 N. Michigan Ave., Chicago 1, Ill.
DERMON BUILDING, MEMPHIS 3, TENN.

CHAPMAN

Penta Preservative

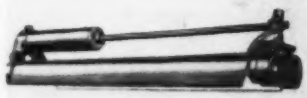
Conforming to A.W.P.A. Specifications P8-49 and P9-49



interference or disturbance on the primary side.

The secondary winding of the transformer is completely enclosed in a copper electrostatic shield. Metallic-shielded secondary cables are integrally attached to the copper shield which is grounded.

Ratings are from ½ kva to 15 kva.
Acme Electric Corp, Cuba, N. Y.



Explosion Proof Fixture

A new type series EVF explosion-proof fixture for 36-w, 48-in. T-12 slimline lamps has recently been developed.

The fixtures consist basically of two, three, and four lamps. They are enclosed with explosion resistant Pyrex glass. Above the lamp tubes is mounted a cast aluminum ballast housing. The fixtures are supplied with sheet aluminum reflectors mounted between the lamp tubes and ballast housing.

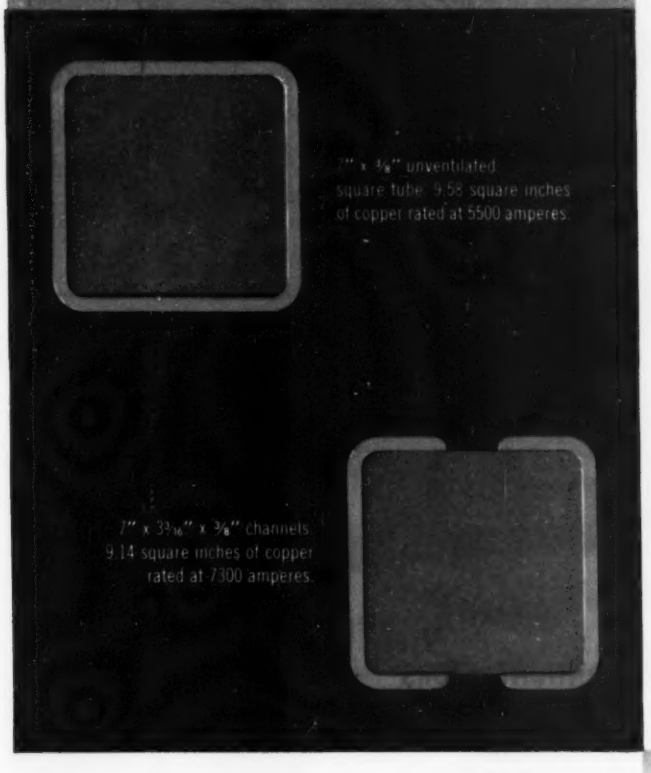
Standard fixtures are arranged for ordinary vertical mounting, but an attachment for mounting at 45 degrees is also available. This angle mounting feature is desirable in many field situations.

Crouse-Hinds Co, New York, N. Y.

Magnetic Tachometer

This magnetic or eddy current type hand tachometer is now furnished with a new limit stop to protect the

CURRENT FACTS ABOUT BUS CONDUCTORS


7" x ¼" unventilated
square tube: 9.58 square inches
of copper rated at 5500 amperes
7" x 3⅛" x ⅜" channels:
9.14 square inches of copper
rated at 7300 amperes

Channel square bus conductors possess greater capacity–

save on copper

Here is another example of how Anaconda designs and makes bus conductors to fit practically any job imaginable. Above, left, is diagrammed an ordinary unventilated square bus conductor. Note that it requires more copper and delivers a lower rated amperage than the ventilated channel square hollow ANACONDA Bus Conductor at the right. The reason for this is simple. Two copper channels, arranged to form a hollow square with longitudinal ventilation slots vertically above each other, provide a larger surface area for dissipating heat. Consequently the amount of current that can be carried is increased.

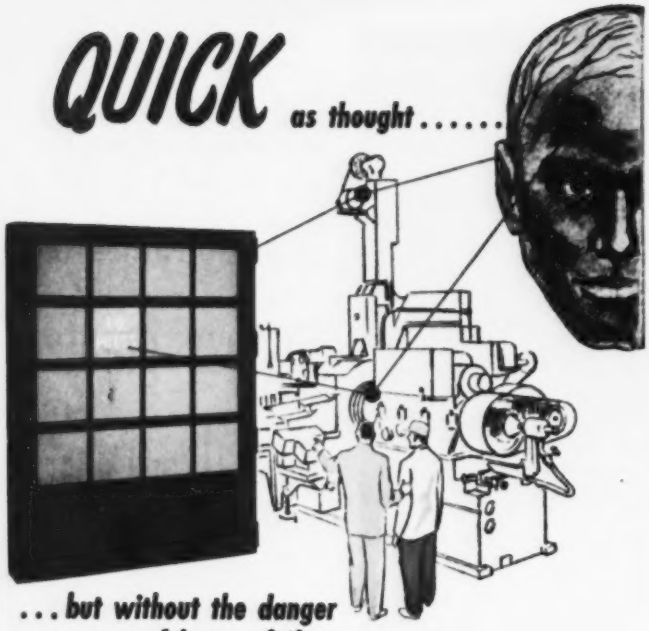
There is a complete line of ANACONDA Copper Bus Conductor designs for every type of installation and power requirement including flat bars, round tubes, channel busses, angle square hollow busses, square tubes and cable conductors.
The American Brass Company, Waterbury 20, Connecticut.
In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

52162

free book!

Write today for latest revised edition of the illustrated book, "ANACONDA Copper Bus Conductors." It contains a wealth of information about new designs and arrangements for bus conductors. It may help you solve your bus design problems.

carry the load with ANACONDA® bus conductors



AUTH

SUPERVISORY ANNUNCIATORS

provide audible and visible signals that

- **PROTECT YOUR EQUIPMENT**
- **SPEED YOUR PROCESS**
- **SAVE YOUR PRODUCT**

Dependable AUTH equipment prevents costly breakdown of vital services or expensive equipment by giving insistent visible and audible alarms of such conditions as overheated bearings, low fuel level, high cooling-water temperature, low or high pressure, end of a processing cycle, etc.

AUTH SUPERVISORY ANNUNCIATORS work this way:

when trouble occurs, a supervisory annunciator receives an electrical impulse from a normally open or normally closed, momentary or maintaining contactor, such as a thermostat, pressure or float switch. This impulse is converted in the annunciator circuit to a maintaining circuit that operates a visible signal indicating the source of trouble, and simultaneously sounds an audible alarm. Various operations sequences are available.

Write today for complete descriptive literature, without obligation!

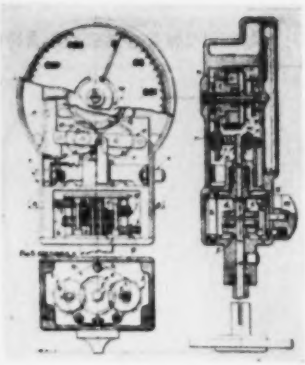
SINCE 1893 AUTH

COMPLETE SYSTEMS • ONE RESPONSIBILITY

AUTH ELECTRIC COMPANY, INC.

34-20 45th St., Long Island City 1, N.Y.

MANUFACTURERS OF: Electrical Signaling, Communication and Protective Equipment for Housing, Hospitals, Schools, Offices, Ships, and Industry.

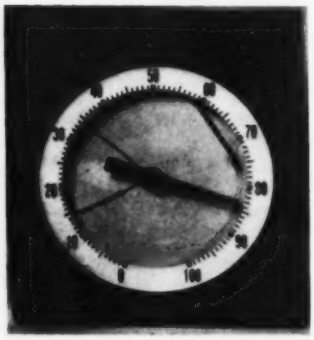


instrument against overrange. The limit stop establishes a fixed arc through which the drag cup can travel.

Since there are no mechanical connections between the drag cup and revolving alnico magnet, the magnet merely revolves at a faster speed inside the cup and the drag cup is held firmly against the limit stop by the higher induced magnetic torque.

Unit also features 0.5% accuracy at any speed.

Equipose Controls, Inc, P. O. Box 269, Bronxville, N. Y.



Inductance-Bridge Receiver

A new receiver for measurement and control of flow and liquid level is called the Electronik inductance-bridge receiver.

This instrument makes it possible to indicate, record, integrate and control flow and liquid level. Data can also be transmitted pneumatically to a second receiver remotely located.

Accurate to within plus or minus ½ of 1 percent of full scale, the instrument combines the time-proven

Built to Last...

P-L

4-WAY ANCHOR

Heavier — Stronger — Easier To Install

Built to Last . . . with heavy gauge steel used throughout. Deeply embossed and ribbed to withstand heavy loads without buckling.

Built to Last . . . because blades are correctly aligned with grain of steel to prevent tearing and breaking, absolute necessity for anchor strength.

Easier to Install . . . because properly curved blades glide smoothly and easily into solid, undisturbed earth.

PL-52-4

Available in 8" diameter with 100, 115 and 135 square inch expanded area. 2-Way Anchor also available in 6" and 8" diameter with 58 square inch to 138 square inch expanded areas.

Also Heavy Duty 4-Way Anchors in 10" diameter with 200 square inch expanded area. Designed for use on power transmission and heavy distribution lines.

Double thick metal takes driving force of tamping bar. Extra width of blade at hinge point, plus proper grain alignment, prevent breaking or buckling.

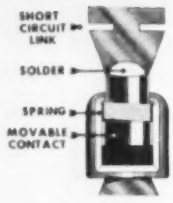
Shaped blades give greater holding power because they penetrate solid earth without loosening it. Blades deeply ribbed for extra strength.

Base plate formed from heavy boiler plate, embossed and flanged for added rigidity and strength.

PIEPER P-L LILLARD, INC.

TELEPHONE TERRYHILL 3-2525 — 122 N. KIRKWOOD RD. • ST. LOUIS 22, MO.

ORIGINATORS OF THE BENDING HINGE ANCHOR



When the tripping temperature of the Trion's Therm-A-Trip melts the contact release, the movable contact driven by its heavy spring opens the circuit.

It takes a long time to heat a block of copper hot enough to melt a piece of solder attached to it. Trion's patented contact-release works in the same way. The solder of its contact-release melts only when the copper mass of its movable contact becomes sufficiently hot.

Trion's Therm-A-Trip element of solid copper is matched to the thermal capacity of the motor or transformer it protects.

Trion blows only when temperatures rise due to "sustained" over-currents. It has the longest safe time-delay of any fuse — five times longer than ordinary fuses. Thus does it give fullest protection and prevent many unnecessary shut-downs.

Trion PROTECTS 3 WAYS

1 Short Circuit Protection: Instantaneous cut-off on a short circuit. The short circuit link blows instantly.

2 Overload Protection: THERM-A-TRIP's positive matched heat control — with the longest safe time-lag of any overload protective device — provides safe starting for motors, and protection from single phasing.

3 Cooling: Trion's lower watt loss makes it the coolest operating fuse of any type. Trion prevents overheating of switches and fuse clips.

A TRION FOR EVERY CIRCUIT. Trions are available in 141 Standard Sizes ranging from 1 to 600 amps for both 250 and 600 Volt circuits. Other sizes for these same voltages range from 1/10 amp to 9 amps. Midget Sizes (3/8" dia. by 1 1/2" long) vary from 1/10 amp to 10 amps. ASK FOR TRION OR WRITE FOR FREE TRION BULLETIN #506-A TODAY.

REGISTERED U.S. PATENT OFFICE

Trion — Home of the Switch

THE CHASE-SHAWMUT CO.

370 MERRIMAC STREET • NEWBURYPORT, MASSACHUSETTS

Ampstop Trion -td- C-O-T Trimet C-O-T FUSE WIRE

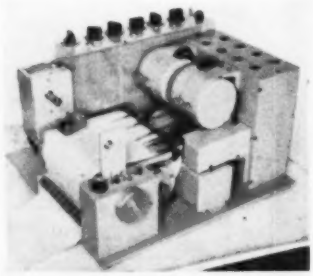
inductance-bridge transmission system with the continuous balance system for power positioning of the pen.

Minneapolis-Honeywell Regulator Co, Wayne & Windrim Ave, Philadelphia 44, Pa.

Air-Hydraulic Tool

A tool for staking pressure wire terminals houses the power of a hydraulic tool in the compact, light body of a hand tool. It is designed to operate on regular shop air pressures of 75 and 150 psi. Operating on Pascal's principle, it is designed to produce 100 lbs pressure for every ounce of its weight.

The Thomas and Betts Co, 14 Butler St, Elizabeth, N. J.



Recorder-Amplifier System

This new device is a multi-channel system providing nine channels for direct recording of transient phenomena. It is reportedly suited for telemetering problems wherein a 0-20cps flat frequency response is re-

Joslyn

JUNIOR LUMINAIRES

FOR Improved

RESIDENTIAL STREET LIGHTING

Controlled illumination with attractive enclosed units at low cost

1 Narrow asymmetrical light pattern for residential streets

2 Totally enclosed glassware unit —die cast aluminum head—Alzak* aluminum reflector—Joslyn wedge-band gasketless glassware seal—Holophane refractor or rippled globe

3 Combines the advantages of a larger luminaire in a small, compact, less expensive unit

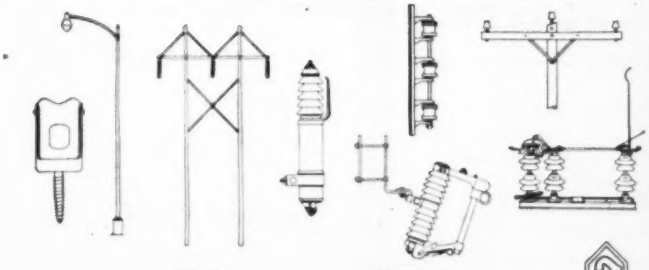
4 Designed also for top mounting with die cast aluminum or D. P. porcelain heads

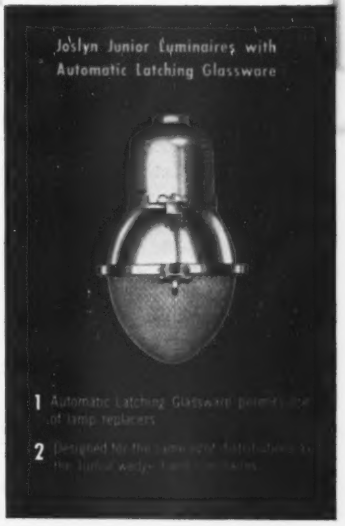
*Manufactured under Aluminum Co. of America patents

Available for

I. E. S. TYPES II, II Four-Way, IV AND V LIGHT DISTRIBUTIONS with 1000 or 2500 lumen lamps

Now **Also Available**





Complete Line Equipment

Joslyn

MFG. AND SUPPLY CO.

20 North Wacker Drive • Chicago 6, Ill.

BRANCH OFFICES IN PRINCIPAL CITIES

The Joslyn Co. • The South East Joslyn Co. • Southern Joslyn Co. • Joslyn Southwest Co. • Joslyn Pacific Co.

You can REDUCE equipment failure

● Use Electro Custom Processed Varnished Insulation to INCREASE LIFE EXPECTANCY and to *insure* the *safe, successful operation* of *electrical equipment.*

Selecting dependable insulation need not present any problem to design, insulation and maintenance engineers if they specify ELECTRO. Our method of processing produces varnished insulation with the ESSENTIAL SAFETY FACTORS.

You may buy with confidence when you buy these

ELECTRO

TECHNICAL PRODUCTS

- Silicone Varnished Fiberglas*
- Quin-Glas Hi-Temperature Insulation
- Varnished Fiberglas* Cloth
- Electro "300" Combination Slot Insulation
- Treated Asbestos Cloth & Paper
- Flexible Varnished Cambric Tape
- Varnished Condenser Paper
- Varnished Silk and Rayon
- Cable Wrapping Tapes

We invite you to use our Special Service facilities if you need varnished insulation to meet specific requirements. Write or phone Department E-1 for technical data and samples.

ELECTRO-TECHNICAL PRODUCTS

DIVISION OF SUN CHEMICAL CORPORATION

NUTLEY 10, NEW JERSEY

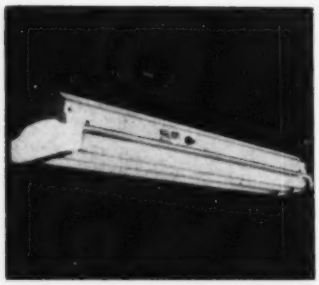
*T. M. Reg. U. S. Pat. Off. by Owens Corning Fiberglas Corp.

quired for normal operations.

Three signal generators providing a 40-mm chart grid width are provided. Five channels are supplied for off-on functions and one channel is assigned to an integral time pulse generator.

Features of the system are a stylus motor system which permits operation in any plane and a six speed semi-automatic chart drive and automatic reroll mechanism.

Rahm Instruments Inc, 12 W. Broadway, New York 7, N. Y.



Open Type Fixtures

A new line of open type commercial fixtures featuring turret sockets is available in 2 and 3 lamp 48, 60 and 96-in. conventional and 48, 72, 96-in. slimline.

With no welded sections they are said to provide the toughest possible resistance to oxidation in installations where extreme humidity prevails.

These commercial units are adaptable to all types of mounting. End piece may be removed and channel coupler added to provide an open wireway of any length. Knockouts are provided for continuous row mounting where open wireway is not required.

Gibson Mfg Co, Atlanta, Ga.

Electronic Winding Tester

A newly developed, portable electronic winding tester is reportedly so sensitive it can detect a single shorted turn of No. 40 AWG wire. Known as the PMD tester, it can be used with equal sensitivity on both ac and dc devices. Unlike ordinary testers the PMD test probes generate their own field in the probes.

The motor tester consists of a power supply unit, a vacuum tube oscillator,

(*Continued on page* 224)

FARGO *Automatic* SPLICES *and* DEAD ENDS *for All Aluminum Conductors*

Made of All Aluminum Parts with the Same Proven Design Features Found in the FARGO Copper Line.

THE "ALS SERIES" AUTOMATIC LINE SPLICE

Thanks to its self-aligned . . . exclusive Fargo "one-piece" jaw — this Fargo Automatic Line Splice is greater in strength — and permanent! It is made entirely of aluminum, with its gripping jaw precision machined to assure full holding power. Individually packed with grease for protection. Available in sizes from 6 Sol. through 397.5 MCM.

THE "SDEA SERIES" SERVICE CABLE DEAD END

Credit the self-aligned . . . exclusive Fargo "one-piece" jaw for the greater ease of installation and better gripping, inherent in this Fargo Dead End, too! It is housed in a casting of "Tenzaloy" (an excellent aluminum alloy) with a rated strength of 1100 lbs.—controlled by its flexible bail wire. Available in sizes from 8 Sol. through 2 Str.

THE FARGO GRIPPING UNIT for DEAD ENDS

It is the Fargo "one-piece" jaw, combined with the Fargo internal sleeve, that accounts for the fast . . . easy installation of all Fargo Dead Ends. It is made entirely of aluminum. The internal sleeve guides the wires through smoothly. Available in clevis type from 6 Sol. through 397.5 MCM, and in detachable bail type from 6 Sol. through 250 MCM.

Ask your Line Material Field Engineer to give you complete details.

FARGO

Manufactured by

FARGO MFG. COMPANY, INC.

Poughkeepsie, N.Y.

Distributed by

LINE MATERIAL COMPANY

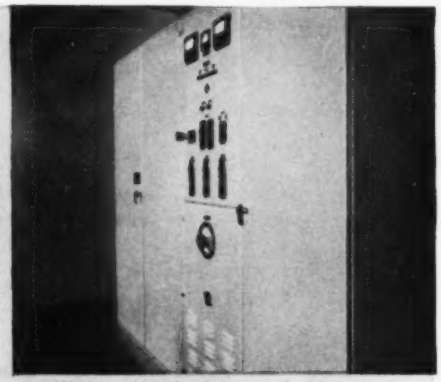
(A McGraw Electric Company Division)

Milwaukee, Wisconsin

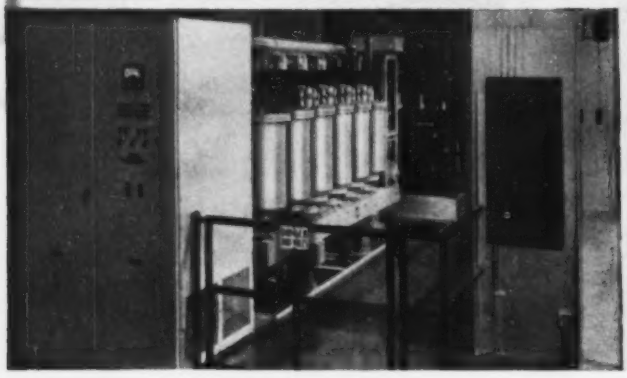
Whether Mine..

ALLIS-CHALMERS MERCURY ARC RECTIFIERS WITH EXCLUSIVE DESIGN FEATURES CAN SUPPLY YOUR DC NEEDS

OUTSIDE view of one of five Allis-Chalmers rectifier substations serving the haulage system of a coal mining operation. Transmission line enters building at right, dc leaves at left. Entire substation can be moved as coal seams are exhausted, leaving only concrete slab behind.



INSIDE is the "dead front," factory packaged, 500 kw, 275 volt dc, sealed tube rectifier. Compartments are (L to R): for rectifier tubes, firing and auxiliary control, dc cathode breaker.



PUMP evacuated rectifiers are applied in heavy duty service from 750 kw up. The 3400 kw, 500 volt unit seen here operates in parallel with steam turbine driven dc generators in the electrolytic reduction of metal.

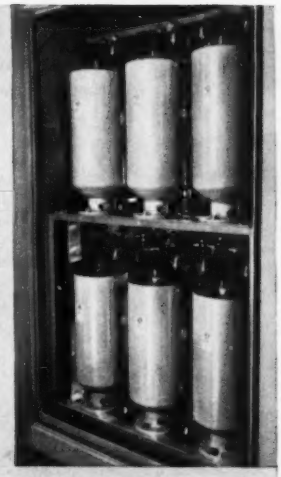
SIDE view of pump evacuated rectifier at left, showing the centralized placement of auxiliaries — exclusively Allis-Chalmers. Both evacuation equipment and heat exchanger are accessibly placed at one end.

ALLIS-CHALMERS

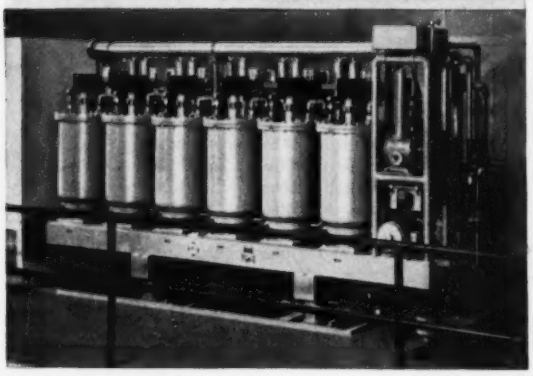
Allis-Chalmers Engineers Introduced Mercury Arc Rectifiers to U.S. Industry

. . or Mill!

MERCURY ARC RECTIFIERS



MODERN Allis-Chalmers design sealed tubes are located in the tube compartment. Other sealed tube units are supplied in ratings from 200 to 1000 kw.



WHEREVER DC IS NEEDED, from the mine to the mill, from the Elevated to the elevator, Allis-Chalmers rectifiers are quietly working away.

They combine the high efficiency, low maintenance characteristics of the mercury arc rectifier with exclusive A-C refinements in design and construction.

Factory packaged, light in weight, and requiring no special foundation, they can be placed right at the load center to cut dc feeder losses. Conversion efficiency is higher at all loads with large power savings during light load periods.

And in addition, only from Allis-Chalmers can you get rectifiers with these exclusive design refinements:

EXCLUSIVE ALLIS-CHALMERS FEATURES

- **Fixed excitation anode** — doesn't contact mercury and is independent of level, turbulence or impurities . . . requiring no adjustment, maintenance or replacement.
- **Continuous excitation** — pilot arc always present, eliminating need for continuous and synchronized re-ignition. Rectifier will ride through severe ac voltage disturbances.
- **Grid phase control** — in cooler and cleaner region near anode, where ion density is lowest.
- **Internal cooling system** — high heat transfer with seamless tube cooling coil located within the rectifier.
- **Arcover-free tank** — eliminates danger of arcing over to tank by insulating entire arc path.
- **Enamelled anode seals** — multi-layer fused vitreous construction provides high-strength seal, unaffected by thermal variation.

All these design advances are obtainable *only* from Allis-Chalmers. When you consider mercury arc rectifiers in your expansion or modernization planning, consider Allis-Chalmers.

For help with rectifier application and a fuller explanation of exclusive superior features, call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3681

10 Mercury Arc Rectifier Advantages:-

★ Compact and light weight ★ No special foundation ★ Push button starting with no synchronizing ★ Quiet operation with high power factor ★ Low idling loss and high conversion efficiency ★ High momentary overload capacity ★ Immunity to frequent short circuits ★ No moving parts, contributing to low maintenance cost ★ No attendance needed during operation ★ Resistant to dust, moisture, fumes ★ Simple construction with long life

A-C ALLIS-CHALMERS

CHOOSE

Collyer

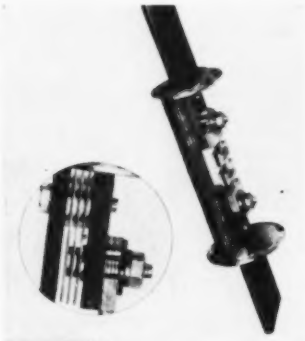
SUPRENE

For samples, prices, and recommendations, write Collyer Insulated Wire Co., 245 Roosevelt Ave., Pawtucket, R. I.

a regulator and rectifier circuit and a full-view, clearly calibrated meter. Total weight is 13 lbs.

Rod-like, single probes are used to test distributed windings. Field coils and squirrel-cage rotors are tested with double probes. The standard test unit is used with either single or double probes, which are available in three basic sizes.

Columbia Technical Corp, 5 E. 57 St, N. Y. C.



Fuse Fins

Heat dissipating fins have been added as a new design feature on several sizes of Monarch renewable knife blade type fuses. Six brass fins with a large area are located three on each side along the fibre bar supports.

The wire and heat transfer surface allows the interior of the fuses to remain cooler with the result that the fuses are even more dependable over their long useful life.

The fins also keep heat from the fibre bar and thus maintain the internal strength for accurate alignment. This feature is presently incorporated in the 600 amp-250v and 400 and 600 amp-600v fuses.

Monarch Fuse Co, Ltd, Jamestown, N. Y.

(*Continued on page* 228)

NOW...new Houdaille *water-oil separator* *for* turbine oils

DRI-PURE

SEPARATES WATER—FILTERS OIL automatically...continuously

New Design . . . New Principle of Operation! Honan-Crane's practical new Houdaille DRI-PURE, for all types of turbines, reduces water content of oil to an insignificant trace . . . maintains clean, dry turbine oil in safe operating condition indefinitely!

COMPLETELY REMOVES ALL CONTAMINATION

The DRI-PURE eliminates the necessity for changing or discarding oil regardless of the type of contamination encountered. This is possible because it performs a complete filtering service—removing solid contamination, acids and other sludge-forming products of oxidation—as it separates the water.

The **DRI-PURE** is easy to install, simple to operate. Replaces tedious, inefficient, dehydration methods; eliminates faulty lubrication and equipment damage. Quickly pays for itself in oil savings alone.

WORLD LEADING OIL FILTER MANUFACTURER

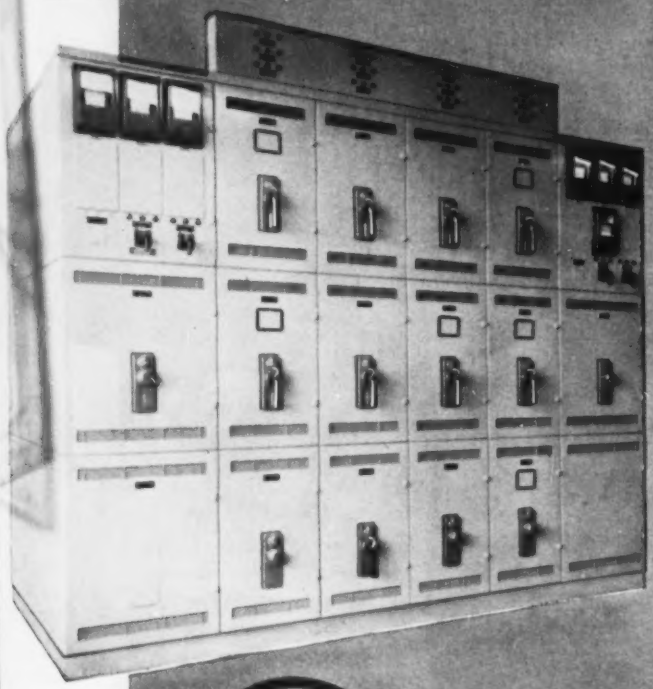
Write today for complete information. Equipment bulletin available on request.

HONAN-CRANE CORP. 819 Wabash Ave., Lebanon, Indiana
a subsidiary of **HOUDAILLE-HERSHEY CORP.**

In Canada:
E. W. PLAYFORD, LTD., Montreal 28
W. E. MICKLETHWAITE, Toronto 18
CUMMINGS GALBRAITH, LTD., Edmonton, Alta.

SWITCHGEAR DEPENDABILITY BEGINS

15,000 TO 100,000 AMPERES INTERRUPTING
600 VOLTS A-C, 250 VOLTS D-C
TO 6,000 AMPERES CONTINUOUS A-C OR D-C,
TO 10,000 AMPERES CONTINUOUS D-C ONLY
INDOOR AND OUTDOOR EQUIPMENT



When you buy low-voltage switchgear you buy protection for personnel and equipment. Protection against costly production loss if power should be interrupted by a "nuisance" overload. Protection against the expense of ruined equipment, spoiled processes, and the ravages of fire resulting from a short circuit. Only *circuit breakers* can provide this type of protection!

And to those fully familiar with *difficult* circuit protection problems, *circuit breaker* means *I-T-E*. The history of low-voltage-circuit protection parallels the development of I-T-E circuit breakers.

I-T-E Low-Voltage Switchgear takes advantage of every feature of I-T-E circuit breakers. Thus, it provides users with required protection and safety—along with bonuses of convenience and neat appearance. By specifying I-T-E Low-Voltage Switchgear, you know you have specified the finest circuit breaker.

You can get the complete story on I-T-E Low-Voltage Switchgear by writing for Catalog Section 6004. The I-T-E Circuit Breaker Company, 19th and Hamilton Streets, Philadelphia 30, Pennsylvania.

Multumite "600" Construction for Types KA, KB, KC and LG drawout air circuit breakers—the combination for complete protection of low-voltage lighting, power, and distribution circuits.

I-T-E

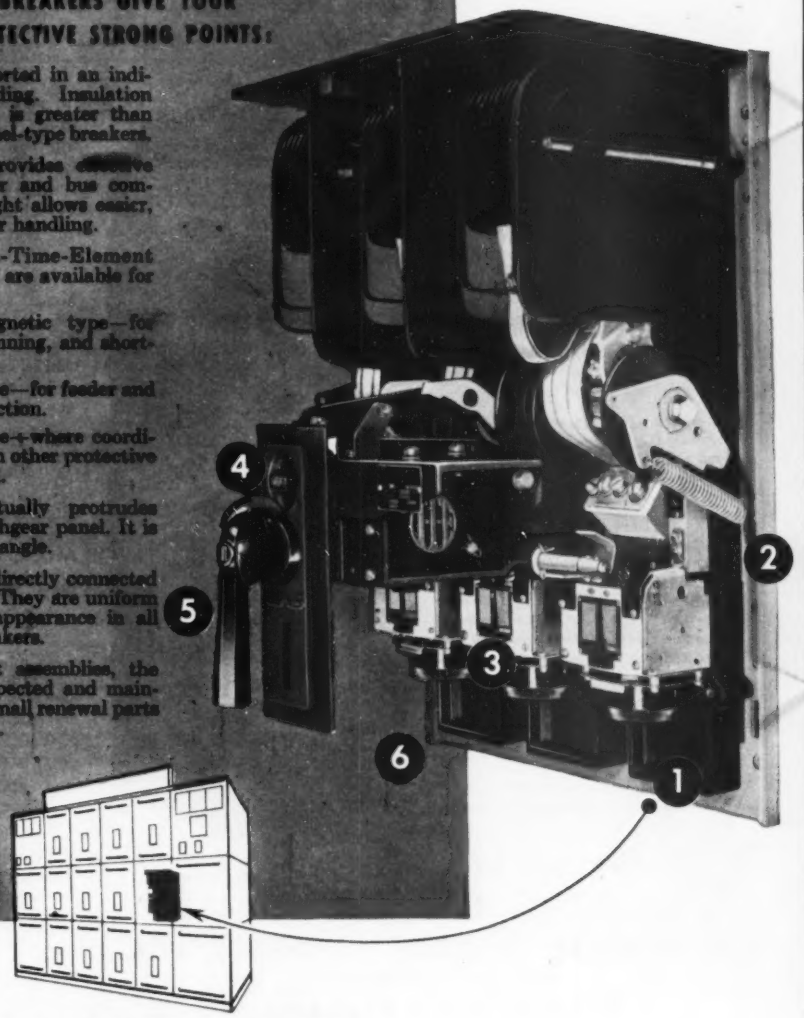
LOW-VOLTAGE

I-T-E CIRCUIT BREAKER COMPANY • 19TH AND HAMILTON STREETS • PHILADELPHIA 30, PA.

WITH CIRCUIT BREAKER PROTECTION!

I-T-E "K" LINE CIRCUIT BREAKERS GIVE YOUR SWITCHGEAR THESE PROTECTIVE STRONG POINTS:

1. Each pole unit is supported in an individual insulating molding. Insulation between adjacent poles is greater than with older, insulated-panel-type breakers.
2. Strong, metal panel provides effective barrier between breaker and bus compartments. Lighter weight allows easier, more convenient breaker handling.
3. Direct acting Inverse-Time-Element overcurrent trip devices are available for every application:
   - Dual thermal-magnetic type—for motor starting, running, and short-circuit protection.
   - Dual magnetic type—for feeder and short-circuit protection.
   - Dual selective type—where coordinated tripping with other protective devices is essential.
4. Position indicator actually protrudes beyond surface of switchgear panel. It is easily visible from any angle.
5. Operating handles are directly connected to breaker mechanism. They are uniform in size, location and appearance in all manually operated breakers.
6. Constructed from unit assemblies, the breakers are easily inspected and maintained. Inventories of small renewal parts are kept to a minimum.



SWITCHGEAR

R&IE Equipment Division: Greensburg, Pa. • Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto • Export Sales: Philips Export Corp., New York 17, N.Y.

STOP CONNECTOR CORROSION FAILURES WITH

TYPE LC CAST ALUMINUM CONNECTORS

FOR Aluminum Distribution Systems

Designed for connecting A.C.S.R. to A.C.S.R. or A.C.S.R. to copper, amerductor and copperweld conductors.

Failures of plated copper or copper alloy connectors installed on A.C.S.R. result from high resistance destructive corrosion of contact surfaces which occurs when copper bleeds through plating causing an electrolytic action with aluminum conductor strands.

Insure against corrosion—specify Type LC —connectors with clamping members of heat treated cast aluminum alloy No. 195 —conductor grooves for copper, amerductor and copperweld conductors incorporate heavy copper liners bonded to connector body by a proven special process.

Backed by many years of coordinated electrical, mechanical and metallurgical engineering knowledge and experience in the design and manufacture of cast aluminum electrical products.

Consult one of our nearest 18 representatives or contact our main office.

OUR PRODUCTS ARE QUALITY CONTROLLED FROM INGOT TO FINISHED PRODUCT

Write today for Catalog Sheets U-3, U-5 and U-6.

ANDERSON BRASS WORKS, Inc.

POST OFFICE DRAWER 2151

BIRMINGHAM, 1, ALABAMA

Light-Heater Unit

This single compact electrical ceiling unit provides radiant heat plus overhead lighting. Called the Electriglas Thermolite, it can be installed in place of an ordinary lighting fixture. This saves space and eliminates the cost of additional heating equipment.

The outer portion of the circular ceiling appliance consists of a panel of shatterproof glass containing a heating element fused into it. When electricity passes through the element the glass becomes the source of radiant heat. Diffused light streams through the white opal glass center lens. Light and heat operate independently.

The light element is rated 250 w and the heater has a 500-w element.

Appleman Glass Works, Bergenfield, N. J.

MORE NEW PRODUCTS

about which you should know

Square D Co has recently announced a new type of **matching knockout** that eliminates time consuming bending when ganging electrical devices. The new knockouts provide ½-¾-in. concentric knockouts with larger knockouts in a tangent pattern. . . . Wac Engineering Co, 35 South St. Clair St, Dayton 2, Ohio has developed a new improved **fluorescent lighting ballast.** The big advantage of the 440-v ballast is that it makes 440-v lighting systems more practical.

Leader Electric Co, 3500 N. Kedzie Ave, Chicago 18, Ill., has designed a modern, **glare free lighting system** for gas stations. Designed for overhead illumination, the Station Master delivers high intensity light at the

(*Continued on page* 232)

Here's all it takes...

for Easy–Safe–Sure
Remote Valve Operation

LimiTorque valve operation is the ultimate in ease and simplicity . . . just the pressure of a finger and LimiTorque will open and close valves up to 120″ diameter.

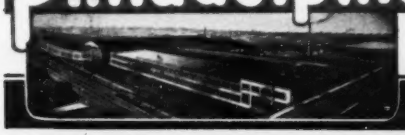
Think of the savings effected in time and money by eliminating men going from one valve to another, many of which are at distant locations—not to mention the time required to shut or open each valve. *LimiTorque Remote Control* not only prevents this waste, but enables one man to operate all valves from a central location and actually see on a panelboard whether the valves are open or closed.

Various types are available for different requirements on all makes of valves: globe, gate, butterfly, plug, etc. *LimiTorque* may be actuated by any power source, such as electricity, water, gas, oil or air. Your valve manufacturer can supply LimiTorque Controls.

LIMITORQUE®

For details, send for our 96-page catalog, L-50.

Philadelphia Gear Works, INC.



ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Facts from
NEBRASKA

"'CSP'® Transformers cut installation _____. costs up to $38 per unit"

"Our urban and close suburban distribution areas (outside the downtown network system) became seriously overloaded, and had to be converted to a higher voltage. Since much of it served desirable residential areas, we were anxious to obtain clean-looking pole tops. Therefore, we decided to use 'CSP' Transformers exclusively," says a Nebraska Utility.

"We realized savings in installation costs averaging $34.37 per unit. Since 650 transformers were involved, a total saving of approximately $22,340 was realized. In addition, we benefit by the greater protection against overloads and short circuits which is inherent with the 'CSP' Transformer and with the continuous load check provided by the signal light.

"We found the following comparison of costs:

Conventional Transformer		*'CSP' Transformer*	
Arrester installed	$29.00	Additional cost of "CSP" over the conventional transformer—includes built-in lightning and thermal protection plus load indicating light	$30.38
Cutout installed	25.00	Higher pole for secondary clearance (required in some instances)	2.00
Two 7-foot crossarms installed	14.00		
One 5-foot arm installed	2.50		
Total	**$70.50**	**Total**	**$32.38"**

Installation and maintenance costs for "CSP" (Completely Self-Protecting) Transformers are always lower, because complete protective equipment is built in, not separately mounted. A two-year survey of Electric Light and Power Companies shows the following:

NATIONAL AVERAGES

	"CSP"	*Conventional*
Installation Cost	$13.87	$24.74
Burn-out Rate	0.257%	1.005%
Fuse Outages	None	5.64% @ $6.52 per outage
Load Checks	Automatic	12.8%
Breaker Reset	1.02%	None

If you'd like to check your own costs against these national averages, ask your Westinghouse representative for Booklet B-4247-B, "Transformer Costs and Their Relation to Profits". Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

"CSP" detices . . . originated and patented by Westinghouse

YOU CAN BE SURE... IF IT'S Westinghouse

"CSP" DISTRIBUTION TRANSFORMERS

J-70597

DRAFT FANS GO on GREEN

- Two Induced Draft Fans, each 198,000 cfm; 300°F stack gas at 15" static pressure.
- And special features include: radial tip blades, erosion-resistant wheels, control type inlet dampers, air-cooled bearing for outdoor service.

This installation, located in the South, adds to the mounting evidence that Green Draft Fans are very much in the boiler plant picture, both utility and industrial . . . evidence that they are high on the specification lists of leading consulting engineering firms and on the owners' lists of acceptable equipment.

There are numerous things about Green Induced and Forced Draft Fans that make them desirable auxiliary equipment for any boiler. We suggest that you have the basic facts at hand when you start planning for your fans. Send for our Bulletin 168 and in writing, tell us about your requirements.

THE GREEN Fuel Economizer COMPANY INC.

- Economizers
- Fans
- Air Heaters
- Cinder traps
- Aerodynamic Dust Collectors

BEACON 3, NEW YORK

Photo above shows the Green ID Fans being installed in the Chesterfield Power Station Extension of the Virginia Electric and Power Co., at Drewrys Bluff, Virginia.

selling zone without creating a barrier of glare. . . . Universal Drafting Machine Corp, Cleveland, Ohio has introduced a new line of Duraline **metal drafting machine scales.** The rules come in 6, 12, 18 and 24-in. lengths, both architects' or engineers' scales.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa. announces a new **industrial luminaire** suitable for operation of two T-17 mogul fluorescent lamps rated at 85, 90, or 100 w. Featured is a rigid lamp holder support. . . . General Electric Co, Pittsfield, Mass. introduced recently a new **rubber-phenolic varnish** that permits the manufacture of laminated plastics having two to three times the impact strength of those made with conventional varnishes.

The Texas Co, 135 E. 42 St, New York announces a new **wire rope lubricant** which will permit applications to wet wire rope because of its unusual penetrating and adhesive properties. It is a thin liquid product that is applied without heating. . . . Minneapolis-Honeywell Regulator Co, Philadelphia 44, Pa. has developed a new **non-indicating pressure controller** for regulating control valves. It is designed for use on process systems in the power and other industries.

Chester Cable Corp, 521 Fifth Ave, Chester, N. Y. has announced the development of a new **insulating compound** suitable for operating temperatures of minus 60C to plus 120C. This compound has been named HLT 500 and is used on transformer leads, motor leads, coil and relay leads and for other confined areas. . . . United Laboratories, Inc, Cleveland, Ohio has improved the properties of **rust preventative paints** so that they will dry in 10 minutes. This feature reportedly reduces painting costs 50 percent.

Air Reduction Co, Inc., New York, N. Y., has announced new **direct current arc welders,** available in 150 and 200-amp sizes. Models are light weight and provide easy portability when mounted on a two-wheeled carriage. . . . C. P. Clare and Co, 4719 W. Sunnyside Ave, Chicago 30, Ill., designed a small, sensitive **low power relay** called the Type N. The relay will operate on 50 milliwatts with a 10,000 ohm coil, 1 Form C contact and a standard adjustment.

VICTOR DISTRIBUTION INSULATORS

NOW EVEN BETTER WITH PURIFIED PORCELAIN!

Spools, guy strains, pintypes, suspensions—all are made of the same new *PURIFIED* PORCELAIN as VICTOR's high voltage transmission types. This means that every VICTOR insulator is a better insulator—with highest insulation values, unequalled density, rock-like strength, hardness and resistance to impact, and a product uniformity never before achieved!

Through years of research, VICTOR has eliminated the last big variable in porcelain-making by removing all mineral salts from water used in processing. Results are reduced fluctuations in shrinkage and density and virtual elimination of microscopic, glass-like impurities which, up to now, have prevented maximum insulator strength and hardness. Remember—VICTOR *PURIFIED* PORCELAIN is the finest insulator porcelain ever made!

VICTOR INSULATORS, INC.
VICTOR, N. Y.

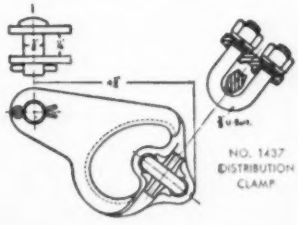
NO. 504
GUY STRAIN

NO. 5 LOW-VOLTAGE
PINTYPE

NO. 2012 SPOOL

NO. 804 SUSPENSION

Specify VICTOR INSULATORS



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CLAMP

DISTRIBUTION LINE HARDWARE

VICTOR carries a complete line of distribution clamps in all required types and materials to accommodate cable sizes from 0.145 to 0.60 inches. Snubbing, quadrant or boltless types in forged steel, malleable iron or pressed steel with or without aluminum liners, according to type and size of cable to be accommodated.

ANOTHER ADVANCE FROM B&W RESEARCH & DEVELOPMENT

Why 26 ELECTRIC UTILITIES B&W pressure-fired boilers

Higher boiler efficiency, lower auxiliary power demands, better operating control, and lower maintenance costs — these are some of the reasons why B&W's pressurized-furnace design is gaining wide acceptance by power companies. At present, 26 electric utilities throughout the country—as well as a number of industrial plants — have in service or on order B&W pressure-fired boilers serving a a total generating capacity of more than 6,000,000 kw. Comprising this total are Radiant, Open-Pass, Integral-Furnace and Stirling units having individual steam capacities ranging between 200,000 and 1,370,000 pounds per hour. Steam-drum design pressures range to 2700 psi and throttle steam temperatures to 1100 F. Fuels include gas, oil and coal—and many units are multi-fuel burning.

Already, several years of intensive operating experience stand behind B&W's pressurized-furnace design. Actual operating units fired with pulverized or crushed coal, including both slag tap and dry ash removal, serve an installed generating capacity of over 1,000,000 kw.

To effect still greater economies in power generation, pressure-firing is often used in combination with various other cost-saving features resulting from B&W's Research and Development program. These include high pressures and temperatures, divided furnaces, cyclone steam separators, gas recirculation, and Cyclone Furnace firing.

We'll be glad to talk over the details of these features in terms of your company's future requirements. The Babcock & Wilcox Company, Boiler Division, 161 E. 42nd Street, New York 17, N. Y.

HAVE SELECTED

B&W Pressure-Fired Boilers
For a Total Generating Capacity of
Over 6,000,000 kw

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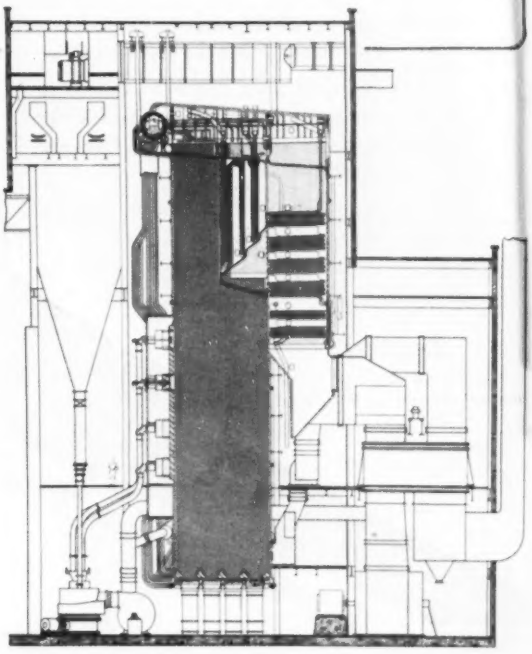

Pressure-Firing, Gas Recirculation, Cyclone Steam Separators, Divided Furnace and Reheat are some of the features of this B&W Radiant Boiler now under construction at a new plant of a leading eastern electric company. Rated steam capacity — 1,370,000 lb. per hr. Design pressure — 2050 psi. Pressure at superheater outlet—1850 psi. Final steam temperature—1000 F. Reheat to 1000 F.

COST-SAVING FEATURES

1. **Increased boiler efficiency.**
2. **Reduced fan power consumption.**
3. **Lower maintenance costs.**
4. **Greater operating reliability.**
5. **Decreased stack losses.**
6. **Simplified outlet duct and stack arrangement.**

G-5527

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NEWS ABOUT PEOPLE

W. W. SPROUL L. B. McCULLY H. E. SEIM

Westinghouse Elects 3 VPs

W. W. Sproul, L. B. McCully, and H. E. Seim are advanced to executive posts. They will head 12 divisions

Westinghouse Electric Corp has elected three vice presidents to head 12 of its 31 divisions. They are W. W. Sproul, L. B. McCully, and H. E. Seim.

Sproul has been elected vice president in charge of the company's general industrial products group of divisions, which comprise the Micarta, Standard Control, Small Motor, Elevator, Sturtevant, Welding, and Lighting Divisions, and Bryant Electric Co, a wholly owned subsidiary at Bridgeport, Conn.

VP of Bryant Electric . . . McCully is now vice president in charge of the Transportation and Generator, and Switchgear Divisions at East Pittsburgh. Seim has been elected vice president in charge of the Sturtevant Division, and Bryant Electric.

Sproul will make his headquarters at Pittsburgh, McCully at East Pittsburgh, and Seim at Boston.

Sproul, who has been sales manager for all industrial products since 1949, joined Westinghouse in 1927. After completing the company's graduate student training course he was assigned to the sales department in the Transformer Division. He became sales manager of that division in 1944.

Began as Trainee . . . McCully, who has been serving as manager of the combined Transportation and Generator Division since 1939, started with Westinghouse in 1916 on the graduate student training course. His first assignment was as a production clerk at East Pittsburgh and by 1928 he was in charge of all production at the company's largest works. He was named superintendent of the Generator Division in 1936.

Seim, who became general manager of the Sturtevant Division in 1948, began with Bryant Electric in 1909 as an office boy. In 25 years he has advanced to the position of vice president and general manager of that company.

Melvin Appointed a VP by Atlantic City Electric

Howard H. Melvin has been appointed vice president of Atlantic City (N. J.) Electric Co. The company also named John L. McDonnell manager in charge of its affairs at Millville.

Melvin, who will have his headquarters at Atlantic City, formerly was executive vice president of Millville Electric Light Co, Cumberland City Gas Co, and Millville Water Co. He became associated with these utilities in 1938 as general manager. In 1943 he was made executive vice president. Melvin, who has been a director of Atlantic City Electric since 1951, is a past president and director of the New Jersey Utilities Association.

H. H. MELVIN

McDonnell became affiliated with the three New Jersey utilities in 1934 as comptroller. He was appointed to the post of secretary in 1945.

Millville Electric Light recently was merged with Atlantic City Electric (EW, May 12, p 22-24), following negotiations which started in March.

L. M. La PORTE

La Porte Made a VP of Wisconsin Electric

Lester M. La Porte, comptroller of Wisconsin Electric Power Co since 1941, has been advanced to vice president and comptroller. In his new post, La Porte will continue in charge of the company's accounting department.

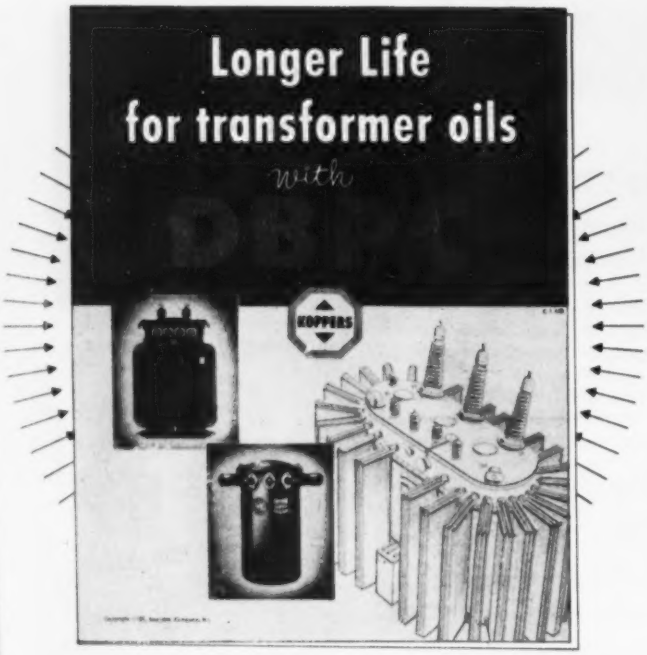
La Porte came to Wisconsin Electric in 1920 as an accountant. He was named auditor of customers accounts in 1925 and was made assistant secretary and assistant treasurer in 1932.

He is a national director of Controllers Institute of America.

John M. Cochran has been appointed superintendent of the Hampden steam

New Free Folder

tells how you can save money by inhibiting oil with DBPC



● If you use transformer oil, you should have a copy of this folder. It describes how Di-tert-butyl-para-cresol (DBPC) inhibits transformer oil against oxidation, and prolongs its useful life many times.

The results of accelerated oxidation tests are given—tests that show DBPC can increase the life of new transformer oil by as much as 1,300 per cent. This folder also tells how old oil treated with fullers earth and inhibited with DBPC produces a rejuvenated oil which can actually outlast brand-new transformer oil that isn't inhibited.

Send for this free folder and find out how DBPC not only saves money but also protects transformers and makes them perform more efficiently.

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plant of Western Massachusetts Electric Co, succeeding Horace D. Walker who has retired. Cochran joined the utility in 1922 and was named chief engineer at Hampden in 1950. Walker served about 33 years in his last post.

DR P. D. MERICA

Merica Elected President of International Nickel

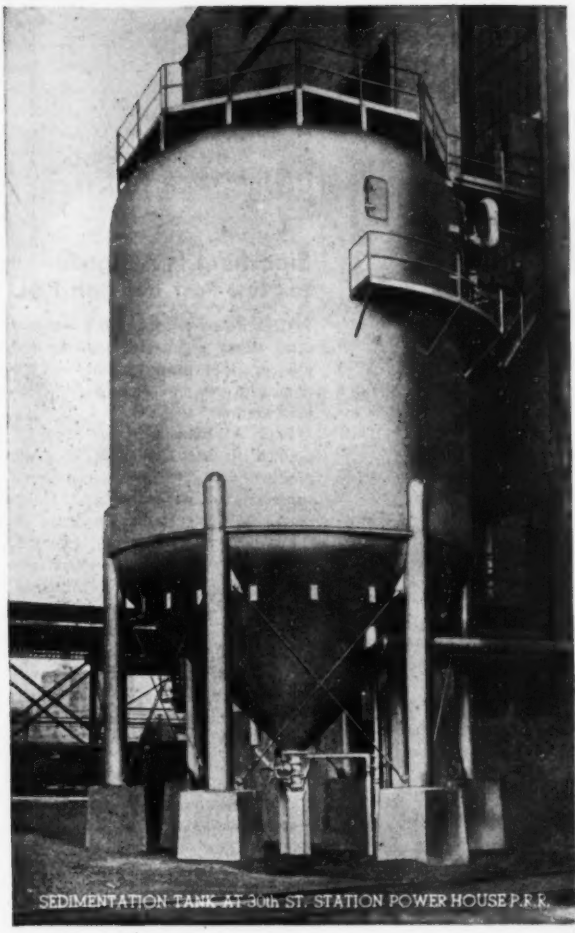
Dr Paul D. Merica, executive vice president and a director of International Nickel Co of Canada, has been elected president. He succeeds Dr John F. Thompson, who will continue as chairman of the board.

The company also named William F. Kennedy secretary, replacing Henry S. Wingate who will devote his full time as vice president.

J. R. Gordon, in addition to serving as assistant vice president, has assumed the duties of assistant general manager. In these capacities he will manage all activities in the Canadian operations under the direction of R. Leslie Beattie, vice president and general manager in charge of this work.

Several executive changes were also made for the company's United States subsidiary, International Nickel Co, Inc.

Merica becomes president with Thompson continuing as chairman of the board. Walter C. Kerrigan, vice president, has been elected to the newly created position of vice president and general sales manager, assuming responsibility for both nickel and mill products sales. L. R. Larson was elected assistant vice president and assistant general sales manager. Theodore H. Dauchy, Richard A. Cabell, and John A. Marsh also have



SEDIMENTATION TANK AT 30th ST. STATION POWER HOUSE P.R.R.

COCHRANE

Hot Process SOFTENER

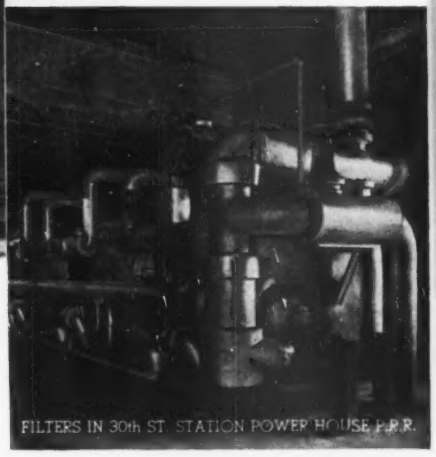
Serves a Great Railroad

ONE of the features of the huge Pennsylvania Station — 30th Street, Philadelphia, of the Pennsylvania Railroad is the ultra modern power plant, designed by internationally recognized architects and engineers.

Recently installed in this power plant to serve additional capacity is a Cochrane Hot Process Softener for the boiler feed. It will handle 80,000 gallons per hour makeup and 10,000 gallons per hour condensate.

Cochrane pioneered the development of the hot process for softening boiler feed, and has continued to lead in the field of water conditioning ever since. In recent years, Cochrane has made many installations of the new Hot Process Zeolite Softener, wherein external second stage of softening is accomplished by means of ion exchange.

Consult Cochrane on any water conditioning problem.



FILTERS IN 30th ST. STATION POWER HOUSE P.R.R.

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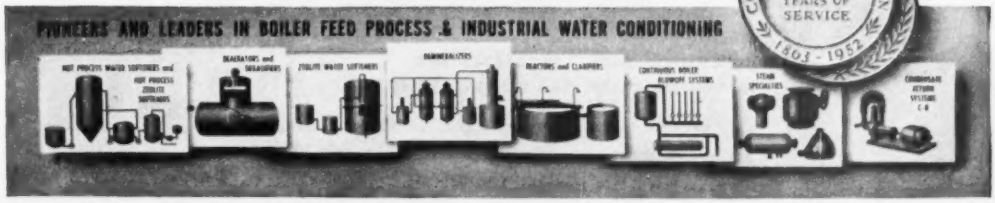
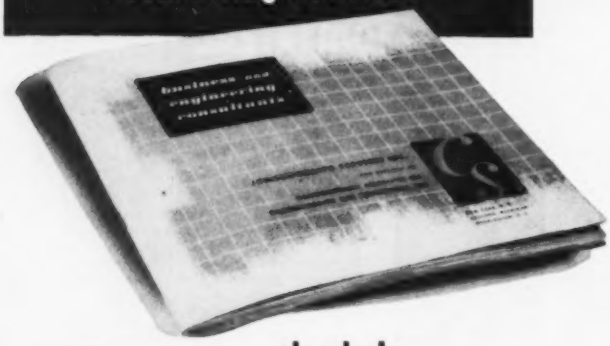


More and more Utilities and Industries find the need for

Consulting Services



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been promoted to assistant vice presidents.

Ralph D. Parker, assistant vice president and general superintendent of the Mining and Smelting Division of International Nickel, has been elected a vice president of the company's subsidiary, Canadian Nickel Co, Ltd.

Blanchard Is Assigned to New Post by Utah P&L

Utah Power & Light Co has named three steam engineering men to new jobs, as a step toward further integration of its growing steam-electric plant organization.

Paul A. Blanchard has been appointed to the new post of steam production engineer, with operational supervision of all steam-electric plants in the system. He is succeeded as mechanical engineer by John S. Anderson, who will deal specifically with steam engineering problems. J. H. Hutchinson is new assistant superintendent at the Hale plant.

Blanchard joined Utah P&L as a plant operator, later becoming a travelling maintenance engineer, assistant plant superintendent, assistant engineer, and finally mechanical engineer in 1951.

Anderson, a native of Scotland, came to this country in 1948. He has worked for Utah P&L at the Hale plant for four years, and became assistant superintendent there in 1950.

Hutchinson came to Utah P&L in 1935, starting in the Salt Lake Division. He has worked as an operator, computer, draftsman, junior and associate results engineer, and ultimately specialized in steam production.

Elected President

Electric Products Co, Cleveland, Ohio, has elected Gordon J. Berry as president. Berry started with the company in the early 30's, beginning as a test engineer. He progressed through the service organization, design engineering, and sales engineering to his recent position as vice president in charge of sales.

C. Harry Anderson has been appointed operating superintendent of the Western Division of Niagara Mohawk Power Corp. He succeeds **Harold R. Waldron,** operating vice presi-

Don't Settle for Less Than . . .

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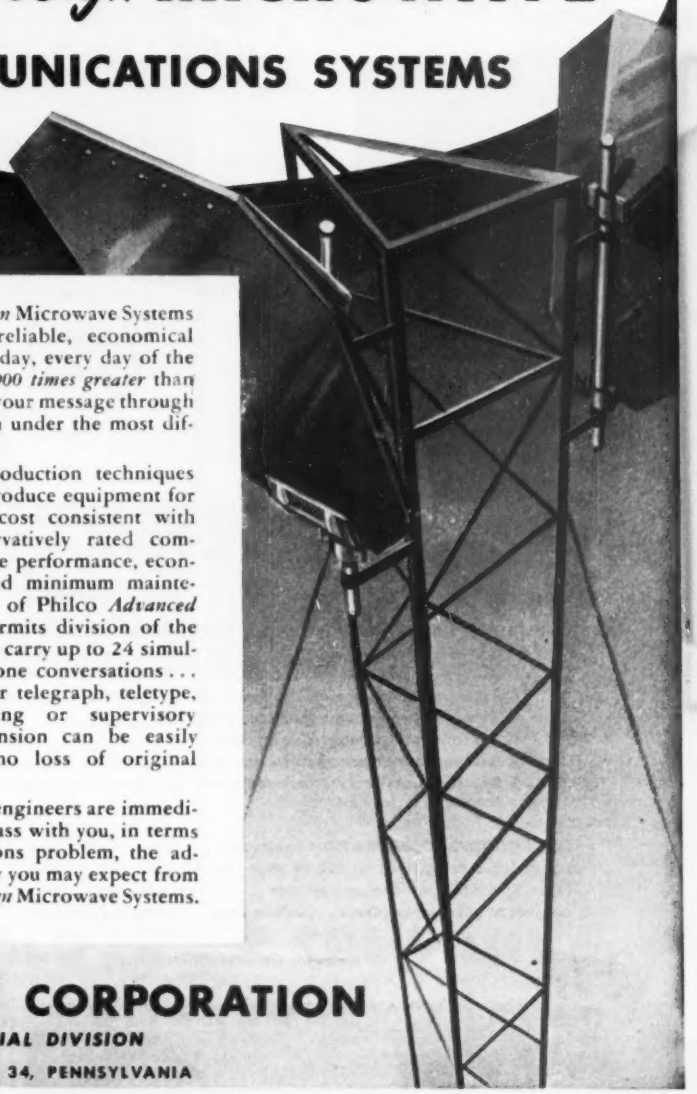
Advanced Design MICROWAVE

COMMUNICATIONS SYSTEMS



Philco *Advanced Design* Microwave Systems are engineered for reliable, economical operation 24 hours a day, every day of the year. A signal level *1000 times greater* than normally needed gets your message through clear and strong, even under the most difficult conditions.

Philco's exclusive production techniques make it possible to produce equipment for the lowest possible cost consistent with high quality. Conservatively rated components insure reliable performance, economy of operation and minimum maintenance. The flexibility of Philco *Advanced Design* Microwave permits division of the broadband channel to carry up to 24 simultaneous 2-way telephone conversations . . . or further division for telegraph, teletype, telemetering, signaling or supervisory circuits. Future expansion can be easily accomplished with no loss of original investment.

Philco regional sales engineers are immediately available to discuss with you, in terms of *your* communications problem, the advantages and economy you may expect from Philco *Advanced Design* Microwave Systems.

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6-POINT CHECK for every REMOTE CONTROL OPERATION

Vital checks in every Remote Control Operation System

***Standard Operating Procedure for Control Corporation's system of supervisory control includes 6 vital checks:**

1. Correct number of audio tones.
2. Tones of specific value, designed for the equipment.
3. Tones of definite and restricted sequence.
4. No tone immediately follows itself.
5. No two tones operate simultaneously.
6. Specific time interval between tones not over 1/10 of a second.

ONLY CONTROL CORPORATION equipment gives you these 6-step operational safeguards to insure year 'round, all-weather *reliability*. Specify Super-Trol and be sure . . . for automatic supervisory control of generating plants . . . substations . . . pumping stations.

Write for General Bulletin AA 2.

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dent, who has retired after 44 years in the electrical industry, the last 27 with Niagara Mohawk and its predecessor companies. Anderson, who started with Niagara Mohawk in 1925, has been general superintendent of operations, including both distribution and generating plants, since 1950.

L. L. YOUELL

Stone & Webster Canada Makes L. L. Youell a VP

Leonard L. Youell has been named a vice president of Stone & Webster Canada, Ltd.

In 1945 he joined Stone & Webster Engineering Corp of Boston and New York, going to Canada as its engineering representative. Since the formation of Stone & Webster Canada in 1950, he has been manager of its head office at Toronto.

Prior to joining Stone & Webster Engineering, he spent 19 years in the United States with the Atmospheric Nitrogen Corp and its successor the Nitrogen Division of Solvay Process Co for whom he served for 15 years as steam engineer.

Landers, Frary, & Clark Elevates Neece, 3 Others

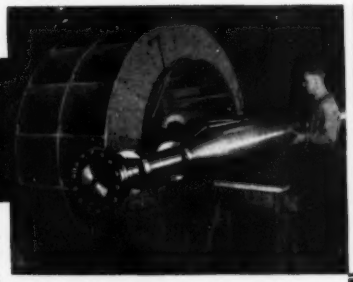
Bret C. Neece has been appointed president of Landers, Frary, & Clark, New Britain, Conn., succeeding Richard L. White, who has been elected chairman of the board of directors.

In other appointments, Albert S. Bross was made vice president in charge of sales, replacing Neece. Donald F. McManus, comptroller, was named treasurer, succeeding White, who also held the post of treasurer.

"Buffalo" *Tips on Getting Best Results With FANS*

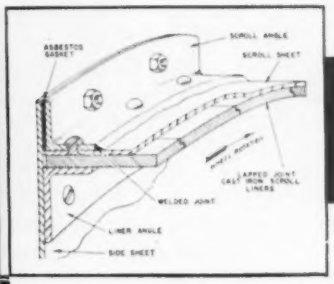
WHAT TO LOOK FOR IN CHOOSING AN INDUCED DRAFT FAN

ADEQUATE SHAFTS, COUPLINGS, BEARINGS



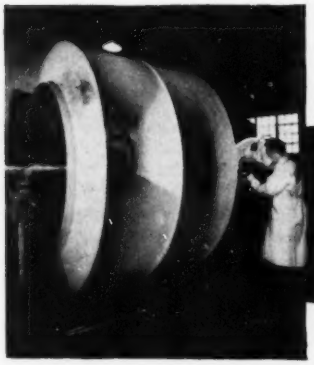
• The above forged steel shaft shows oversize construction in "Buffalo" Fans. Note thrust collars turned out of solid shaft material. Flexible "Buffalo" couplings have rubber bushings and allow for lateral motion. "Buffalo" bearings have large oil reservoirs, large bearing surface, babbitted and lubricated thrust shoulders, are water cooled when necessary.

PROTECTION AGAINST HEAT and EROSION



• Induced draft fans must resist constant heat and storms of erosive fly-ash. Above diagram shows detail of removable scroll liners provided for handling dust-laden air or fly-ash. Rotors may be provided with welded-on wearing strips to further lengthen the life of the already heavy - gauge blades.

EXTRA HEAVY ROTORS DYNAMICALLY BALANCED



• An unbalanced rotor means vibration. With heavy induced draft rotors, this can be destructive to shafts and bearings. All "Buffalo" wheels are balanced at the factory by precision equipment shown above, ready for smooth operation. For additional information on selection of a draft fan, write for BULLETIN 3750.

RUGGED ACCESSIBLE HOUSING CONSTRUCTION

• Heavy steel plate, in removable sections that are easy to handle, makes for ideal induced draft fan housings. The photo above of a "Buffalo" Induced Draft Fan, shows convenience of assembly or dismantling. Note sturdy, oversize construction for long wear. Inlet vanes increase efficiency and minimize erosion.

"Buffalo" FIRST FOR FANS

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Neece, who joined the company in 1923, was appointed general sales manager and elected a vice president in 1938. Bross started with Landers, F&C in 1936 and has been assistant to Neece since 1940. McManus, who came to Landers F&C in 1945, has served as comptroller for the company since 1950.

OBITUARY

R. F. Sikes, 74, manager of the Ennis office of Texas Power & Light Co for 35 years, died April 20 at Dallas.

Fred C. Richardson, 65, a generator designer and power engineer, died April 5. He had served as a generator designer with General Electric Co from 1907 to 1916 and project engineer on the English and Steel Point Stations of United Illuminating Co, New Haven, Conn. At the time of his death he was a mechanical engineer with Westcott & Mapes, Inc, New Haven. He joined the New Haven firm in 1924.

Albert W. **Lee,** 80, who was manager of the Concord (Mass.) Municipal Light Department for 25 years before his retirement, died at Brookline, Mass., April 26.

Clarence C. Rausch, 57, assistant vice president of Dearborn Chemical Co, Chicago, Ill., died April 29 at Houston, Tex. He had been with Dearborn for 32 years, becoming assistant vice president in 1941.

Lucius Beardsley Fuller, 72, retired Utah Power & Light Co chief engineer, died April 10. Fuller had been identified with intermountain electric power development for the past 45 years. His first assignment was with Telluride Power Co, a predecessor company of Utah P&L. He was made chief engineer in 1937.

John Robert Marsh, 56, director of advertising and public relations of Georgia Power Co before his retirement in 1946, died May 5 at Atlanta, Ga. Marsh, who was active in the Public Utility Advertising Association for a number of years, was the husband of the late Margaret Mitchell, author of the novel "Gone With The Wind."

Who short-circuited the Soviet?

(The following sad, amusing tale of Soviet power woes was written by P. Dudochkin, correspondent for "Socialist Agriculture", and appeared in the September 6, 1951, issue. We think it's worth repeating. A quantity of reprints are available if you'd like them.)

LACK OF INSULATORS HOLDS UP FARM ELECTRIFICATION IN SOVIET UNION

"The Porcelain insulator has become a stumbling block in a great State undertaking," writes P. Dudochkin in "Socialist Agriculture" September 6. "The Administration of Rural Electrification apparently does not deem it necessary to bother about such trifles."

The correspondent for "Socialist Agriculture" graphically describes the situation on several collective farms in the Soviet Union.

There was rejoicing in the kolkhoz "Paris Commune," which is located in the city of Kalinin: The electrification of all the villages of the kolkhoz was being completed. Two substations already had been equipped and the motors* were in place ready for production. The electricians were putting up the transmission lines and in a few days the surrounding kolkhozes were to have electricity. The only person who was not happy at the prospect was the senior work superintendent in charge of the electrification.

"I cannot understand how anyone can be in a bad mood when the entire district will be transformed within a week," said the chairman of the kolkhoz "Paris Commune." The work superintendent was silent; he did not wish to grieve the chairman. The great event of turning on the electricity did not materialize. The farms will not have electricity. Nobody knows when they will have it —not even the work superintendent.

'We are obliged to stop work," announced the superintendent. "Why? What is the reason? What is wrong? the questions poured from all sides.

The superintendent took out of his pocket a piece of porcelain tubing with bent ends and put it on the table, saying, "This is what is holding up the work." "But that is an ordinary porcelain insulator, this is a trifle," exclaimed the kolkhoz chairman. "Absolutely correct," agreed the superintendent, "but nothing can be accomplished without it."

"Socialist Agriculture" reports that inquiries at the Kalinin office of rural electrification elicited the following comment from the manager:

We have turbines, generators and all kinds of the latest electrical equipment, but no insulators. Porcelain insulators are worth their weight in gold.

The manager continued:
Owing to the lack of insulators several hydroelectric power stations cannot go into operation, the Krutets in Teblesh raion, the Pereslegin and Senchugov in Vysokov raion, and others. Special messengers have been sent to different cities in search of insulators, without any results. There is only one way out, to make another visit to the Main Administration of Rural Electrification of the Ministry of Agriculture of the USSR.

The paper reports that two trips were made to Moscow, six months apart, but no results have been achieved. Whenever the delegation visited the Ministry, the employees remarked:

"Electrical insulators. But that's a mere trifle. You go out and find them yourself."

The visitors explained the situation, but their request was not satisfied and it has not been satisfied up to the present time.

**Probably should read, "transformers"—may be error in translation, or may mean "motors on farms."*

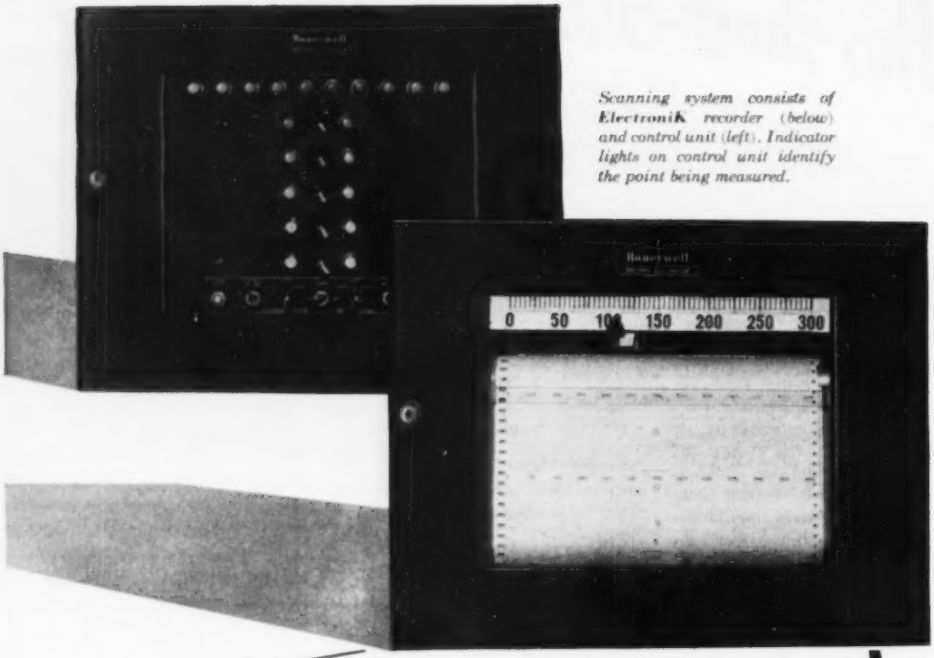
Be thankful there's still free enterprise here to give you all the porcelain insulators you need—NOW!

YOUR INDEPENDENT INSULATOR MANUFACTURER

PP INC.

Porcelain Products, Inc.

FINDLAY, OHIO



Scanning system consists of **ElectroniK** *recorder (below) and control unit (left). Indicator lights on control unit identify the point being measured.*

Versatility and Convenience . . . through these unique features:

Identifies each temperature . . . . Numbered lights signal the thermocouple being measured. Couples are connected in 30 banks of 9 points each.

Flexible Recording . . . . . Choice of four methods: (1) Successive recording of all 270 points; (2) recording only when set point is exceeded; (3) no recording—scanning only; (4) recording only manually selected points.

Individual temperature limits . . . A separate temperature limit, for operating alarms or automatic start of recording, can be set for each bank of 9 couples.

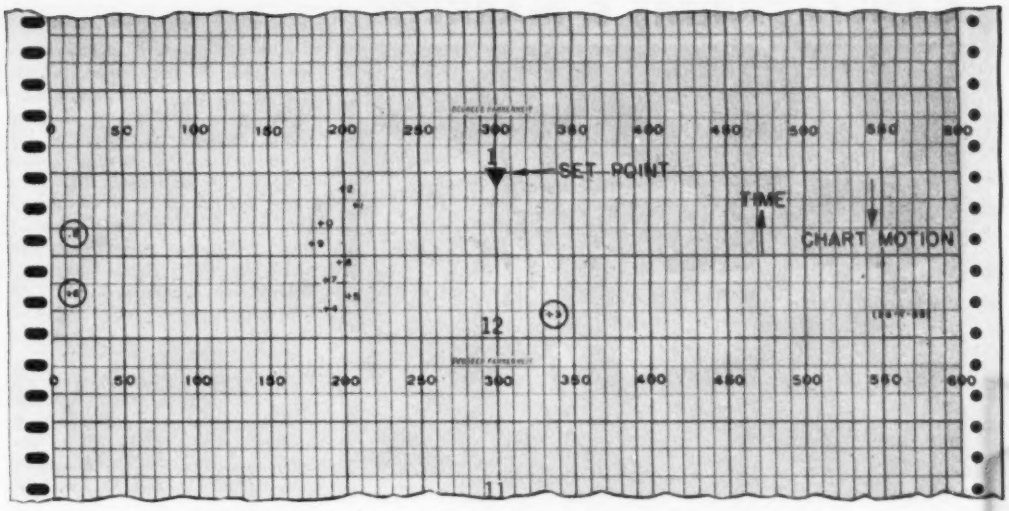
Selective Scanning . . . . . Any bank or banks can be omitted or repeated; choice by selector switches.

Simple Synchronization . . . . . Push-button restoration of proper relation between scanning and printing, if manual operation disturbs synchronization.

Warning Signals . . . . . Operates audible or visual alarms if limit is exceeded by any point.

Fast Scanning . . . . . Average time per point is 1 second, when difference between successive points is 25 per cent of scale span.

Saves Chart Paper . . . . . Chart moves only when instrument is actually recording.



Typical chart record shows how 270 points are recorded on one instrument. Here, point 263 has exceeded the set point. The figures ".2" and "+6" in the left margin identify the first two digits; the last digit, "+3", appears upscale marking the recorded temperature.

Up to 270 plant temperatures *monitored by new* ElectroniK instrument

EVERY power plant has hundreds of potential trouble spots—in bearings, hydraulic couplings, boiler tubes, cooling oil lines—where temperatures should be watched to safeguard equipment and to assure continuous, efficient operation. This new *ElectroniK* instrument affords an automatic, completely reliable means of monitoring these temperatures . . . at unusually low cost per point.

On a single instrument, it can concentrate up to *270 temperatures* . . . bringing them to a single location where operators can inspect them readily. It scans through the thermocouples to which it is connected at a rate of one second per point (when successive temperatures are within 25 per cent of the scale span) . . . checking each point at approximately four-minute intervals. It can perform many functions, at the operator's choice: simple scanning, continuous recording of all points, selective recording, recording of points which depart from specified limits, and operation of annunciator contacts when any point exceeds a preset temperature.

Your savings in labor alone—for manual observation of temperatures and logging of data—will pay for this instrument in short time. And you'll be assured of maximum temperature protection wherever it's needed in your plant.

Ask your local Honeywell engineering representative to discuss your applications for this time-saving, space-saving instrument. Call him today—he is as near as your phone.

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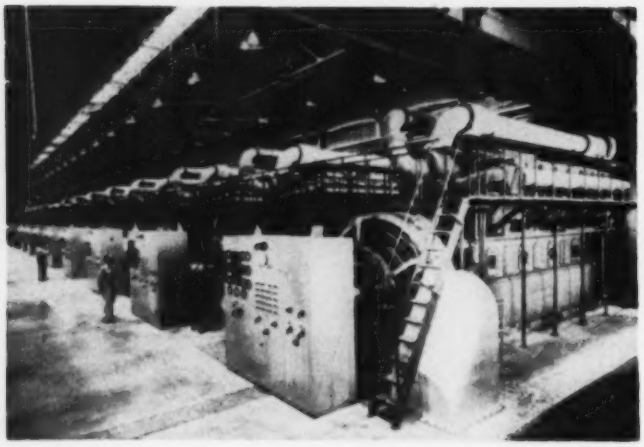
BROWN INSTRUMENTS

First in Controls

● *Important Reference Data*

Write for Instrumentation Data Sheet No. 10.0-9, "*ElectroniK* Scanning System" and for Catalog No. 90-2, "Supervisory Instruments for Power Generation"



BUILDING No. 41 at Reynolds Metals Co's recently dedicated San Patricio aluminum reduction plant near Corpus Christi, Tex., houses these 16 giant Cooper-Bessemer engines. Each of the building's 33 gas engines, all of which are not shown, generates 2,500 kw. The units are part of an $80 million installation which can produce 160 million lbs of aluminum a year

Reynolds Dedicates Plant

Company's new, $80-million San Patricio, Tex., works to be operated by its own 187,000-kw power unit

Dedication ceremonies for Reynolds Metals Co's new, $80-million San Patricio aluminum reduction plant near Corpus Christi, Tex., were held May 15.

This plant, which is located on a 160-acre site, will make 160 million lb of aluminum annually with its four huge pot rooms which are nearly a third of a mile long.

Has Power Plant . . . With the dedication of this plant, Reynolds can now boast of having one of the largest electric generating plants of its kind. Unlike many other aluminum reduction plants, San Patricio is not dependent upon outside electric power for its operation.

Its huge generating plant contains 41-3,000 hp engines and 42-3,700 hp engines—a total of 278,400 hp. These engines in turn drive 41-2,000 kw electric generators and 42-2,500 kw generators with a total output of 187,000 kw, sufficient to supply all the residences in Houston, Dallas, San Antonio, and Ft. Worth.

The power generating equipment is housed in three buildings.

Building No. 40, which is 315 ft long, 72 ft wide, houses the ac generator sets where electricity used to run auxiliaries and lighting is produced by nine Cooper-Bessemer 16-cylinder supercharged gas engines rated at 2,500 kw, 4,160 v.

Building No. 41 houses 33 giant Cooper-Bessemer engines, fueled by natural gas, which are already in operation generating electric power for one of the plant's two aluminum pot lines. Each engine drives a 2,500-kw dc generator. The building is 462 ft long, 147 ft wide.

2-Story Unit . . . Building No. 42 is where the General Motors engines are being installed to supply electricity for the other aluminum pot line. It is a two-story unit 560 ft long, 61 ft wide, 13 ft from the ground to the second floor, and 33 ft from the second floor to the eaves. This building will house 41 General Motors gas-burning diesels of a new type. Each engine has 16 cylinders, arranged like two V-eights, V-to-V stood on end. The vertical shafts of these engines, which are located on the second level, extend through the floor to drive 41-2,000-kw dc generators on the ground floor.

Although these huge engines run on natural gas, they are supercharged like aircraft engines, a unique and relatively recent development affording record breaking fuel economy and much more power in the same amount of space. The natural gas used is rated 1,000 Btu per cu ft. There are oil type gas scrubbers and a metering house for each of the two gas lines which supply the plant. Total plant consumption is estimated to be 48 million cu ft per day—17.5 billion cu ft a year.

Plant Layout . . . The layout of the San Patricio plant, whose buildings contain approximately 1 million sq ft of floor space, provides for the four pot rooms, each 1,580 ft long, to be arranged alongside each other with the electric power plants at one end. This arrangement results in the least possible length of bus with the lowest possible power loss.

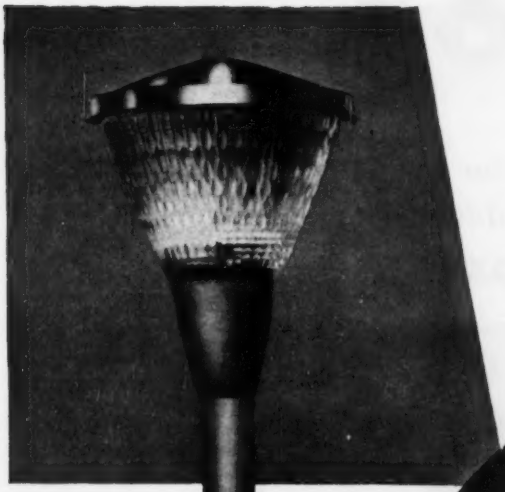
Each pot in a conventional pot line operates at a voltage drop of 4.5 to 5.5 v and dc electric generators operate most efficiently at several hundred volts. Therefore, the pots are connected in series. Six hundred volts at 32,000 to 50,000 amp will handle the electric power requirements of a conventional pot line.

Bus bars connect the generators to the first pots in each building in a pot line. Electricity is conducted from pot to pot in one building till it reaches the far end. Other bus bars then connect to the next building, where the current is carried from pot to pot back until it reaches the end of the second building . . . near the generator plant . . . the electricity having made a complete circuit down one building and back up the length of the other. Thus two rooms are employed to make a single pot line.

The General Motors power plant operates one pot line (two pot rooms). Its 41-2,000 kw generator sets total 82,000 kw normal rating. The Cooper-Bessemer power plant operates the second pot line (the third and fourth pot rooms). Its 33-2,500 kw generator sets have a total normal rating of 82,-500 kw.

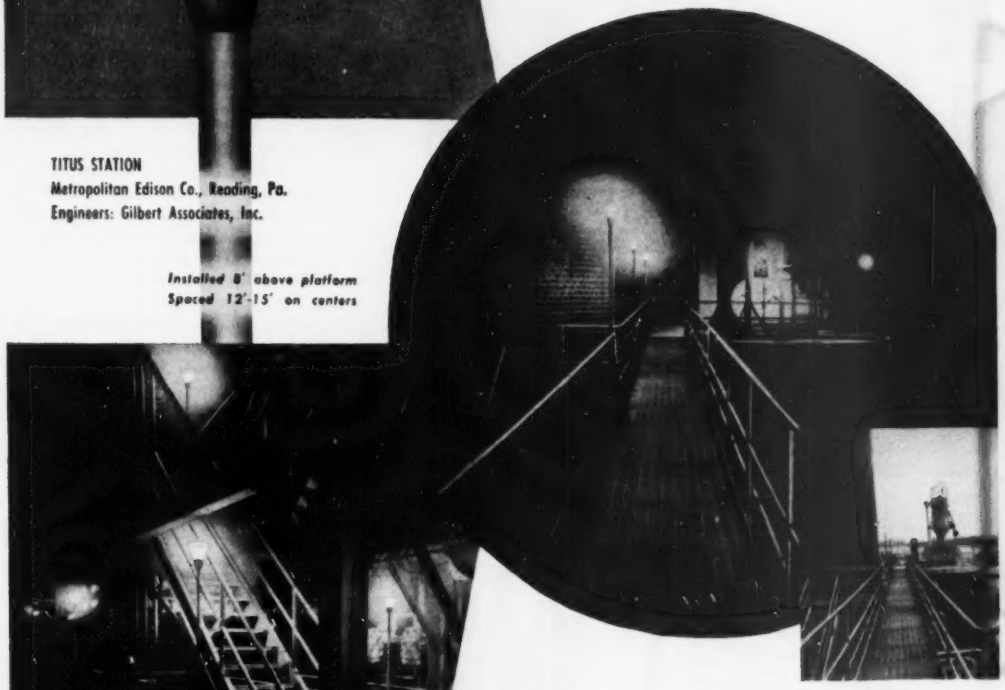
Controls for regulation of the output from the General Motors and Cooper-Bessemer power plants to both pot lines are centrally located on one panel under the control of one operator.

Outdoor Lighting for Modern Plants featuring the HOLOPHANE A-WAY* POSTOP*



TITUS STATION
Metropolitan Edison Co., Reading, Pa.
Engineers: Gilbert Associates, Inc.

Installed 8' above platform
Spaced 12'-15' on centers



The A-WAY POSTOP serves a three-fold purpose for industrial plants: (1) Increased pedestrian and vehicular safety; (2) Protection against after-dark intruders; (3) Illumination of work locations . . . It provides rail-lighting for catwalks at outdoor boiler plants and oil refineries, also lighting for passageways, driveways and walks. Its distribution is asymmetrical, redirecting light usually wasted and adding it to required areas, with excellent uniformity. Sturdily built, totally enclosed, POSTOP is weather proof and designed for enduring, easily-maintained serviceability.

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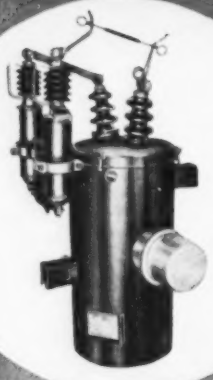

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Appliance Cutback

Manufacturers slash their production and furlough employees during May

While the proponents and opponents of the suspension of all controls on consumer installment purchases wage a battle over the merits of the Federal Reserve Board's recent action, several manufacturers of appliances have cut production and made employment layoffs.

A 50% Cut . . . Starting today General Electric Co's production of refrigerators at Erie, Pa., will be off 50%. The company will lay off about 2,500 persons. Beginning today, automatic washer production at Trenton, N. J., will be cut 25% and 80 employees will be furloughed.

On May 26 production on garbage disposers at White Plains, N. Y., is expected to pick up again at a lower rate than was maintained before operations were stopped May 5. At White Plains there will be a layoff of a few employees.

All these products—refrigerators, automatic washers, and garbage disposers—are made by the Major Appliance Division.

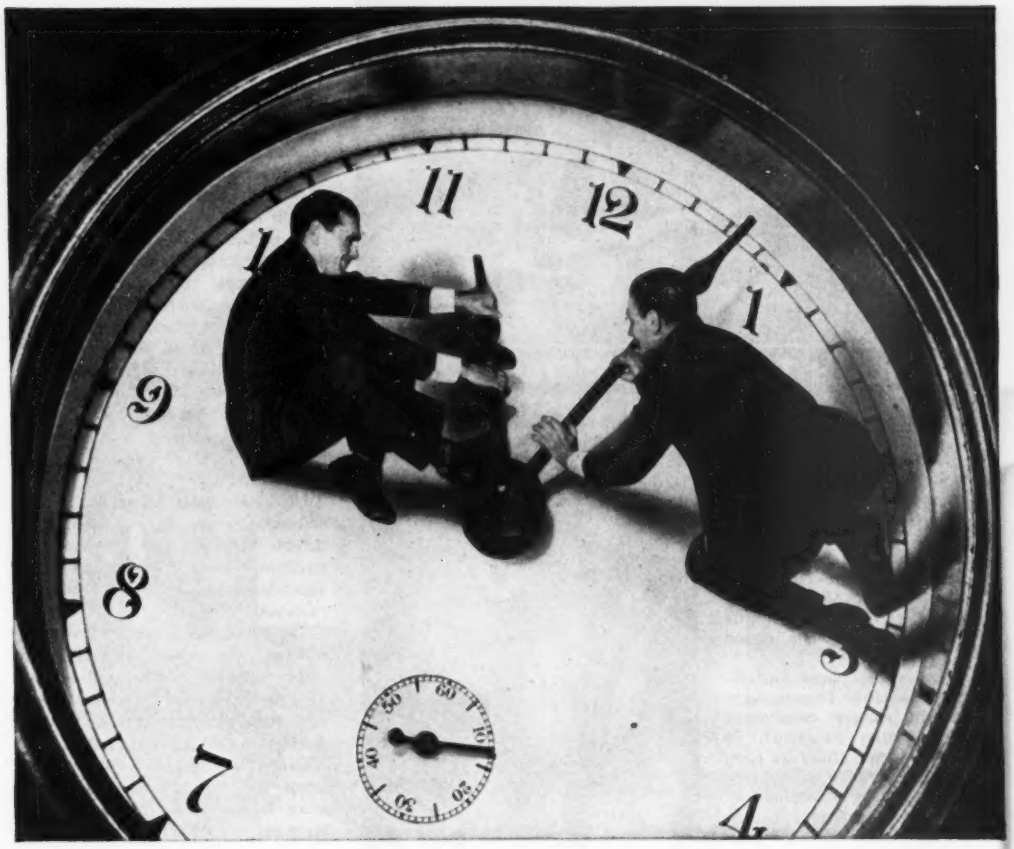
Overall production of GE's small appliances is off about 10% from the first quarter. No layoffs have been made in this field.

Westinghouse Furloughs 300 . . . Of the 6,000 persons employed by Westinghouse Electric Corp at its Appliance Division plant at Mansfield, Ohio, approximately 300 are now on furlough.

Westinghouse has reported a cut of approximately 20% in electric range production. According to company officials the cut was made to gear production to sales. The company furloughed more than 100 employees on the electric range line May 12. This figure represents a 25% cut in employment.

Westinghouse has called back 20 of 220 furloughed employees on the refrigerator production line. However the shifts for the electric roaster oven line have been increased to three, boosting output of this appliance by 40%.

Production Maintained . . . Other production lines such as automatic



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Perhaps yours is a sales and marketing problem. EBASCO has planned many such programs in a wide variety of fields. EBASCO has developed insurance and pension plans; handled appraisals; planned and built over one billion dollars worth of new plants; solved financing and production problems; planned effective personnel programs. EBASCO has been serving business and industry throughout the world for nearly 50 years. EBASCO will do all or any part of a job, for companies large and small.

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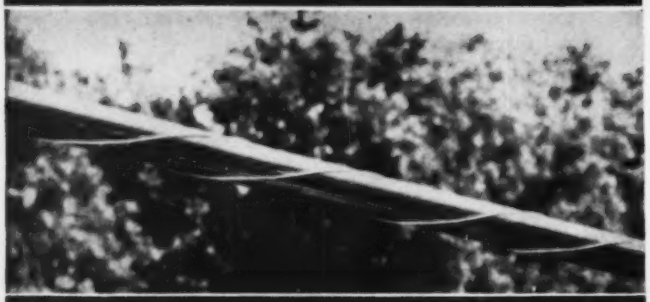

THROUGH TREE-CONGESTED AREAS AT MUCH LESS COST . . .

You can save man-hours of wood-cutting and customer complaints when you spin cable through tree-congested areas. What is more, spun cable costs much less to install than pre-assembled cable. Spun cable is so compact that it saves valuable space wherever congestion is a problem.

You save splices and installation labor, because light weight single conductor cables may be spun in lengths three times as long as pre-assembled cables.

You reduce your cable inventories, because 1/c, 2/c and 3/c cables can be spun in the field as required.

Add to these benefits the extra margin of protection against storm damage . . . and you readily understand why there is a marked trend to cable spinning in the power field.

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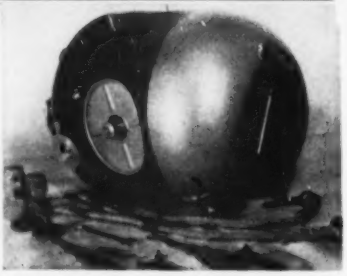
HOW IT WORKS

Drum rotates when its two friction drive wheels respond to pulling of wire. Drum revolves once when 13' of wire is pulled – regardless of condition of strand. Drum carries two spools of wire, each spirals 13' giving support every 6½". Magnesium castings used wherever possible for lightness and strength. Weight: only 36 lbs. Overall length: 18⅝".



CABLE SPINNING EQUIPMENT CO.

TOPEKA, KANSAS Phone 2-7234-5

washers, clothes dryers, dish washers, and electric housewares are continuing at scheduled rates and there is no current Westinghouse plan to reduce production on these items.

Frigidaire Division of General Motors Corp has announced it is in the process of furloughing 2,000 of its 18,500 employees during the month of May.

Cancellation of Frigidaire's two largest defense contracts was caused by the recent changes in the country's national defense program.

"It had been planned originally to transfer employees from appliance production to defense, as they were needed, but the cancellations of the contracts prevented the carrying out of this arrangement," the company stated.

To Intensify Sales Efforts . . . "We are making every effort to obtain new defense contracts and also are intensifying in every way possible our appliance sales activities, Frigidaire explained.

The appliance producers have attributed the cutbacks of appliances and employment to a chain of events. They have admitted they were being strangled by factory stocks because distributors and stores are not placing orders in any substantial quantity. It seems the consumer is putting his spare money into personal savings. He is not rushing out to buy refrigerators or other appliances that are not needed to beat shortages now.

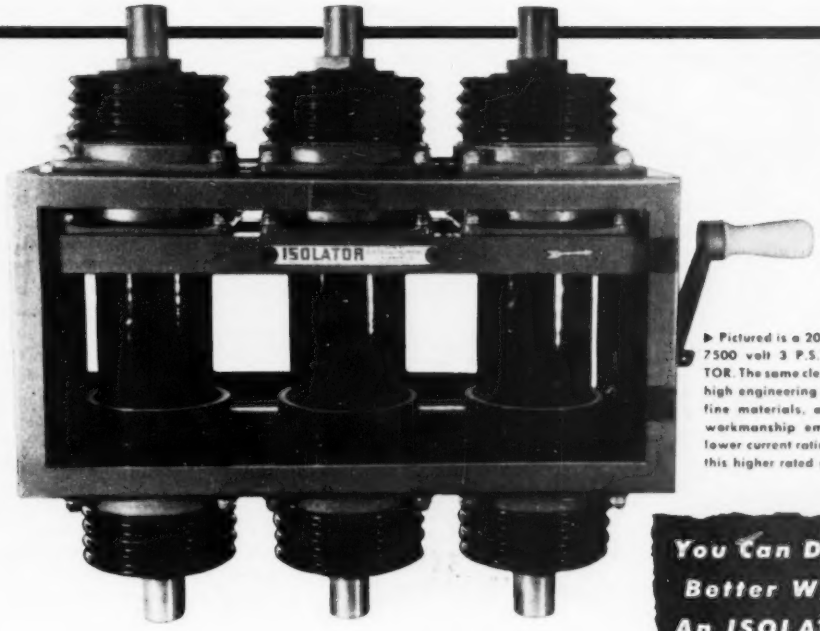
The public's reaction to the FRB's recent decision, which should be apparent in the next few weeks, may determine whether or not appliance production will continue to be slashed or resumed and later increased.

MANUFACTURING BRIEFS

General Electric Co has added three new buildings to its Transformer and Allied Products Division facilities at Pittsfield, Mass. The wire building contains 61,000 sq ft of floor space; test building, 13,972 sq ft; and tube rolling building, 19,548 sq ft. The new additions cost more than $6 million.

Westinghouse Electric Corp has moved its Technical Publicity department to 401 Liberty Ave., Pittsburgh 30, Pa.

THE ISOLATOR KEEPS PACE WITH POWER DEMANDS



▶ Pictured is a 2000 ampere 7500 volt 3 P.S.T., ISOLATOR. The same clever design, high engineering standards, fine materials, and skilled workmanship employed in lower current ratings go into this higher rated unit.

You Can Do It Better With An ISOLATOR

▶The constantly rising demand for electric power necessitates its distribution in large blocks. Heavy duty Three E ISOLATORS are available to meet this trend.

Standard ISOLATORS are manufactured in current ratings of 200 amperes at 5000 volts through 2000 amperes to 15000 volts.

Ask for Bulletin 140 and learn of the many advantages you can receive by using this superior disconnect.

THE ISOLATOR ALWAYS PROVIDES THESE INHERENT BENEFITS . . .

1. *Saving of space in bus structures, cubicles, or vaults.*
2. *Economy in first cost and installation.*
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4. *Safety provided by enclosure of current paths, and with terminals easily insulated.*

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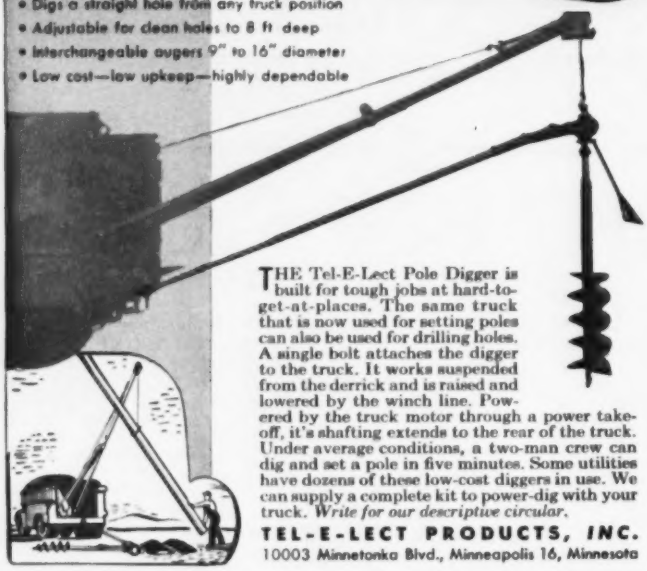

THE Tel-E-Lect Pole Digger is built for tough jobs at hard-to-get-at-places. The same truck that is now used for setting poles can also be used for drilling holes. A single bolt attaches the digger to the truck. It works suspended from the derrick and is raised and lowered by the winch line. Powered by the truck motor through a power take-off, it's shafting extends to the rear of the truck. Under average conditions, a two-man crew can dig and set a pole in five minutes. Some utilities have dozens of these low-cost diggers in use. We can supply a complete kit to power-dig with your truck. *Write for our descriptive circular.*

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TYPE CC

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SINCE 1904

WHAT THEY'RE SAYING

At Industry Meetings

Overvalue of Hydro Resources

HOWARD M. TURNER, consulting engineer, before New England-New York Inter-Agency Committee now investigating northeastern resources for the President of the United States.

Undeveloped water power is so attractive and interesting, that its part in New England's power situation has been greatly exaggerated. The prime problem is how and when it can be fitted into the power pattern and its effect on the cost of electricity. The FPC estimates that in the next 20 years all New England, except Maine, will need about 2.4 million kw additional power. Assuming that undeveloped hydro can furnish 25% of this additional power, the remaining 1.8 million kw will have to come from steam.

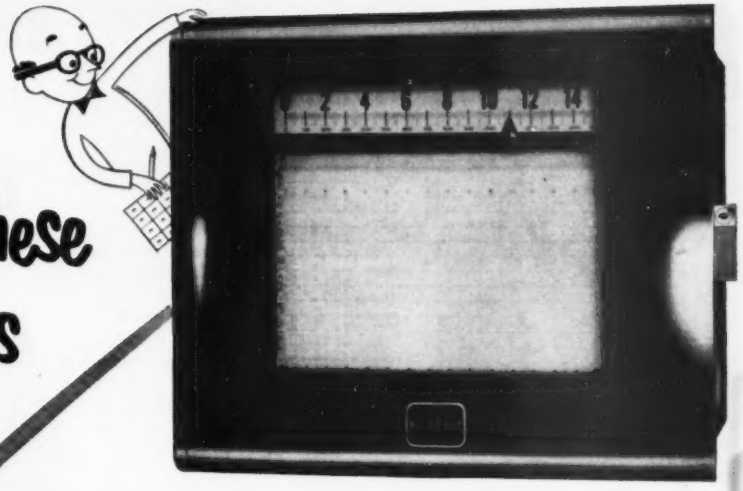
The total wholesale cost of power generation and of hydroelectric long distance transmission is about 40% of the total cost to the consumer. Distribution and other costs cannot be affected by any change in the generating cost. Hydros are generally developed when their estimated earnings are in competition with steam.

I do not mean that all the feasible hydro should not be developed as rapidly as it can be economically absorbed in the future. I believe that these undeveloped hydro resources should be put in their proper perspective. In New England water power has already been developed to nearly as high a point as any region in the country. The total requirements for electricity greatly exceed present and feasible undeveloped hydro. Their development can have but a small effect on the total electric bill.

Correcting Socialist Ideology

EDWIN VENNARD, Middle West Service Co, before first annual American Power Conference at Chicago, Ill.

It is generally recognized that the government's role in the electric power industry is that of a regulator. Under American tradition and principle it is not intended that government should engage in business competitive with its citizens. The government is however in this electric power business in a large way and is



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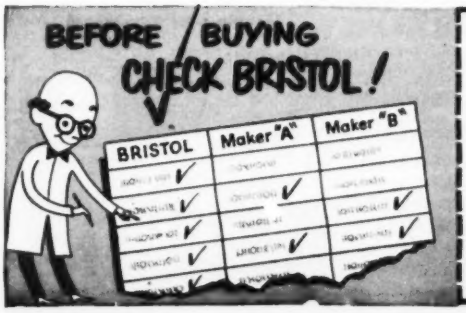

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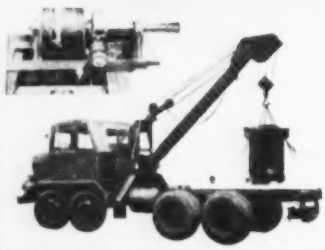

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using all of its influence to go into the business even further.

There are two things that business can do in this "public power vs private power" controversy. First, let businessmen charged with the responsibility of operating American industry so conduct their business as to continually earn the respect of customers, employees and property owners. Also, let the men in government charged with the responsibility of regulation, keep their own house in order and diligently carry out their duties maintaining fair play and honesty. Secondly pass on to the people the facts because the first leanings toward Communism and Socialism, a resultant of government controlled business, can be traced back to lack of knowledge of the facts.

Government Priorities

I. C. JEFFREY, deputy chief, Minor Requirements Branch, DEPA, before Missouri State Municipal Utilities Association at St. Louis, Mo.

The applications, forms, letters, appeals, etc, that are submitted by utilities, are received and processed by either the Power Supply Division or the Materials and Equipment Division of DEPA. The former handles matters of generating capacity, system interconnection, power interchange, system and power loads. Processing applications for construction, allotment of controlled material, authorization of priority ratings, scheduling major equipment manufacture and expediting assistance to electric utilities falls under the responsibility of the latter. Some utilities have experienced difficulty in determining the proper classification for major construction and minor construction projects.

Any utility is authorized by Order M-50 to use the appropriate allotment symbol on purchase orders for controlled material each calendar quarter up to the amount of its quota for that quarter, if the receipt of such controlled material does not cause its inventory to exceed a 90 day supply. If stocks of controlled materials on hand at the start of any quarter are sufficient to meet estimated requirements and provide the maximum permissible inventory, the utility is not entitled to order additional controlled material, even if its quota has not been used. DEPA should then be instructed to reduce or cancel the quota for that quarter.

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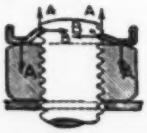
Absolute Security—Low Cost

PALNUT Lock Nuts apply on top of ordinary nuts. No interfering parts within the nut, no spring washers between nut and seat to interfere with maximum bolt loading, or to reduce electrical conductivity. Nut cannot loosen—bolt cannot back out under severest vibration. Very low in cost; easy, speedy assembly; may be removed and re-used; special finishes for utility use.

Double Locking Action

Powerful spring tension (A-A) is exerted upward on the bolt threads and downward on the ordinary nut, while slotted jaws (B-B) close in and grip the bolt like a chuck.



Samples and literature on request

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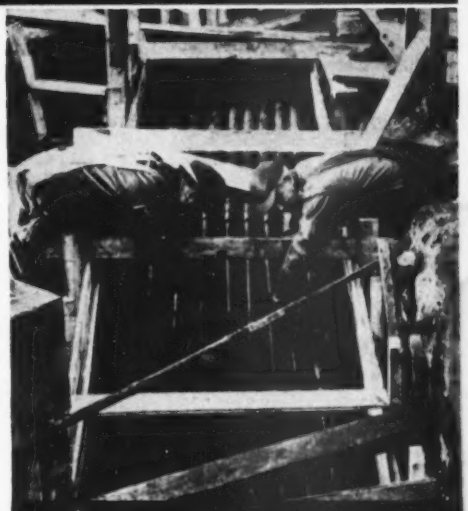
ORANGEBURG *Fibre* CONDUIT

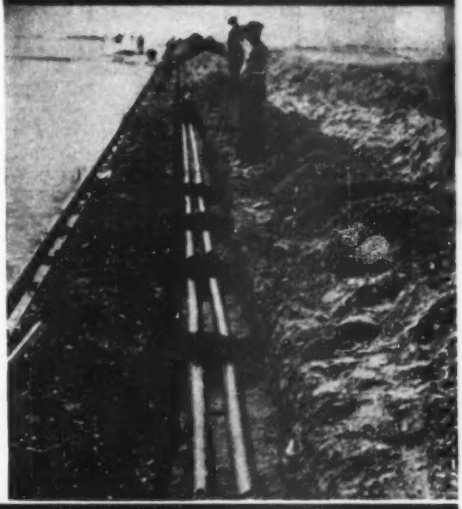
STANDARD *installed with Concrete* · **NOCRETE** *installed without Concrete*

THE trend is to underground. Result—the demand for Orangeburg Electrical Conduit is the greatest in 59 years. Public utilities, municipalities, industrial organizations and institutions are turning to Orangeburg Fibre Conduit more than ever for the permanent protection of their electrical services underground.



STANDARD for three or more ducts installed *with* concrete encasement.

NOCRETE for one or two ducts installed *without* concrete encasement.



WHY ORANGEBURG IS A LEADER IN EVERY CITY AND STATE

Orangeburg leads because it gives complete cable protection at lowest costs.

It is tough and resilient—lasts indefinitely.

Its impermeable walls and tight joints prevent corrosive ground waters from entering.

Smooth bore, low coefficient of friction, keep pulling tensions on cables to minimum.

Orangeburg protects cable sheaths from abrasion when cables are pulled in.

Long 8 ft. lengths, light in weight speed installations.

Taper-Sleeve Joints are made water tight by a few light taps of hammer.

Orangeburg lays faster and at lower cost than any other type of conduit.

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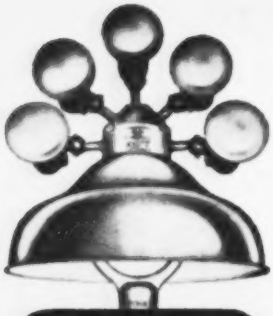

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STONCO ISLAND-AREA LIGHT

Use with or without cluster lights—add lights at any time. No splice box or other accessories needed. Cluster lights screw into pre-tapped, built-in cast aluminum bonnet.

You save at least an hour's wiring time when you install or add cluster lights. Removable front cover makes wiring and splicing easier and speeds up entire job. All wiring fully enclosed.

20" heavy gauge steel reflector finished in vitreous porcelain enamel inside and out—available in red, white, blue, cream, light green and dark green.

STOP EARLY BURNOUTS!

Cooler lamps have longer life. Stonco "Cushion-Seal" lamp holder assures maximum lamp cooling by *completely* exposing the hot-spot filament area to open air circulation. Makes a perfect weather-tight seal on all lamps—long or short—PAR-38 or R-40, medium or mogul. Write Stonco Electric Products Co., 485 Henry St., Elizabeth, N. J.

STONCO

New Electrical Construction

New electrical construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included.

UTILITIES

Proposed Construction

Ariz., Goodyear—Dpt. Navy, San Diego, Calif., rehabilitate and expand electrical facilities at Litchfield Park Naval Air Base, NOY 71102, Spec. 32656. $100,000.

California—Bureau Reclamation, Dpt. Interior, Folsom, construction of Nimbus Dam power plant, and appurtenant works, Folsom Unit, American River Division, Central Valley Proj., approx. 15 mi. northeast of Sacramento, Spec. DC 3713. L. N. McClellan, Bldg. 53, Denver Federal Center, Denver, Colo., ch. engr.

Calif., Davis—U. S. Eng., Wright Bldg., Sacramento, AAG transmitter station, near here. Spec. 1624.

Conn., New Britain—Radio Station WKNB, Julius Gross, pres., New Britain, television station, studios and facilities to reach radius about 45 miles, $500,000.

Kan., Protection—City, power plant imprvs. incl. bldg. work, standby engine, switchboard, cooling tower, $100,000. Lynn Wymer, city engr.

Nebraska—McCook Public Power Dist., 109 East C St., McCook, two 69 kv-7.2/12.5 kv, 750 kva sub-stations, in Red Willow and Frontier Counties. Plans deposit $10.

N. C., Fort Bragg—U. S. Eng., 308 Customhouse, Wilmington, primary electrical distr. sys. incl. conversion of 4,160 volt sect. of electrical distr. sys. to 12 kv, incl. changes and addns. to existing sub-station, Serial No. ENG 31-075-52-28.

Oregon—Bonneville Power Admin., 827 N.E. Oregon St., Portland, construct Schedules 1, 2 and 4, Redmon-Klamath Falls 230 kv transmission line, 154 mi. Deschutes and Klamath Counties, Inv. 6458. Plans deposit $25.

S. C., Parris Island—Navy Dpt., Officer in Charge of Construction, Box 365, Naval Base, Charleston, electrical switchgear for Marine Corps Recruit Depot, NOY 72930. Plans deposit $10.

South Dakota—Bureau Reclamation, Dpt. Interior, Bldg. 53, Denver Federal Center, Denver, Colo., deicing power transformers and air-switch assemblies for Fort Randall Switchyard, Transmission Div., Missouri River Basin Proj., Inv. No. DS-3677.

S. D., Rapid City—U. S. Eng., 1709 Jackson St., Omaha, Neb., electric service for maintenance docks at Rapid City Air Force Base, Inv. 52-98.

Tex., Burkburnett—City, electric generating plant unit, $90,000. Joe E. Ward, 545 Nacol Bldg., Wichita Falls, engr.

Va., Norfolk—P. Wks. Office, Headquarters, Fifth Naval Dist., U. S. Naval Base, Zone 11, addnl. electrical service at U. S. Naval Amphibious Base, Little Creek, NOY 72458. Spec. 33637. Plans deposit $10.

Wyoming—Tri County Electric Assn., Sundance, Wyo., 143 mi. rural distr. lines, in Crook, Weston and Campbell Counties, $175,000. H. S. Nixon Eng. Wo., W. O. W. Bldg., Omaha, Neb., engrs.

Que., St. Hubert—M. P. McAndrew, engr., Defence Constr. 1951 Ltd., 1247 Guy St., Montreal, electrical distr. system for Govt. of Canada, Dpt. National Defence AIR, Cartier Sq., Ottawa, Ont. Plans deposit $100.

Low Bidders & Contracts Awarded

Ark., Stamps—Arkansas Power & Light Co., Simmons National Bldg., Pine Bluff, Ark., Owner Builds, $100,000. Harvey Couch Generating Plant addns.

Colorado—Eagle Erection Co., Shoshoni, Wyo., LB, $1,098,296 est. $1,141,862, Pole Hill Power plant and switchyard and

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This program, performed by our highly skilled crews, can save your system hundreds of thousands of dollars in REPLACEMENT COSTS by

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Get the price on the Chevrolet truck that's the right size, type and capacity for your work. You'll find that it lists for less than any other truck capable of doing the same job. Chevrolet has the lowest priced line in its field.

Fact No. 2

YOU SAVE ON COST PER MILE

You can't beat Chevrolet's Valve-in-Head engine for over-all economy—fuel, oil, upkeep. It just keeps rolling along. And extra-rugged frame, hypoid rear axle, and Flexi-Mounted cab mean longer life, lower maintenance.

Fact No. 3

YOU GET THE RIGHT TRUCK FOR THE JOB

No truck is worth the price if it doesn't get the job done—fast and sure. Chevrolet trucks are *factory-matched* to the payload, *factory-matched* to the job. There's a standard body and chassis, or chassis for special body, that's just right for your work.

Fact No. 4

YOUR TRUCK INVESTMENT IS SAFER!

Comes time to trade in an old Chevrolet truck for a new one, here's good news: Year after year, used Chevrolet trucks traditionally bring more money compared to what they cost, than other makes. The demand is there, because Chevrolet trucks stand up better.

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TWO GREAT VALVE-IN-HEAD ENGINES—Loadmaster or the Thriftmaster—to give you greater power per gallon, lower cost per load • POWER-JET CARBURETOR—for smooth, quick acceleration response • DIAPHRAGM SPRING CLUTCH—for easy-action engagement • SYNCHRO-MESH TRANSMISSION—for fast, smooth shifting • HYPOID REAR AXLE—for dependability and long life • TORQUE-ACTION BRAKES—on light-duty models • PROVED DEPENDABLE DOUBLE-ARTICULATED BRAKES—on medium-duty models • TWIN-ACTION REAR BRAKES—on heavy-duty models • DUAL-SHOE PARKING BRAKE—for greater holding ability on heavy-duty models • CAB SEAT—with double-deck springs for complete riding comfort • VENTI-PANES—for improved cab ventilation • WIDE-BASE WHEELS—for increased tire mileage • BALL-TYPE STEERING—for easier handling • UNIT-DESIGNED BODIES—for greater load protection • ADVANCE-DESIGN STYLING—for increased comfort and modern appearance.

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The 7-Range Clip-On Volt-Ammeter

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Offers These Important Advantages

- Measures up to 1000 amps—up to 600 volts
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- Takes cables up to 2¼" diameter.
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- Suitable for 50-70 cycles.

RANGES: 0-10 amps; 0-25 amps; 0-100 amps; 0-250 amps; 0-1000 amps; 0-150 volts; 0-600 volts.

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FROM the smallest hand operated, to the large motor operated, MURRAY Gate Hoists are designed and built in a wide range of capacities, from less than 1 ton to over 100 tons.

During our over half century of designing and building gate hoists, we have developed many designs for the different types of gate hoist problems. Perhaps we have several designs and patterns that will fit your requirements. In planning gates or gate hoists, we suggest you communicate with us before your plans for the project as a whole, are complete . . . it will save expense and much preparation time.

We also build gate hoists especially from your plans and specifications, if desired.

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Flatiron Power and pumping plant and switchyard and installation of equipment in Garter Lake pressure tunnel valve shaft, Colorado-Big Thompson Proj. Spec. BC-3691. Bureau Reclamation Dpt. Interior, Loveland, Colo. Bids Apr. 29.

Ill., Chicago—O'Brien Co., 819 S. Tripp St., Chicago, Ill., CA, $100,000, 2nd story 8,000 sq. ft. factory addn. Minerallac Electric Co., 25 N. Peoria St., Chicago, Ill. Monroe Bowman & Assocs., 221 N. La Salle St., Chicago 1, Ill., archts.

Iowa—Hoak Constr. Co., 621 6th St., Des Moines, Ia., CA, $71,118, 28.7 mi. rural distr. lines and sys. imprvs., Henry Co. Southeast Iowa Co.-operative Electric Assoc., Mt. Pleasant, Ia. Stanley Eng. Co., Hershey Bldg., Muscatine, Ia., engr.

Missouri—Berger Constr. Co., Higgins-Moines, Ia., CA, $71,119, 28.7 mi. rural distr. lines Caldwell, Carroll, Charlton, Clinton, Daviess, DeKalb, Linn, Livingston and Ray Counties, Proj. Missouri 42X-Caldwell. Farmers' Electric Co-operative, Inc., Chillicothe, Mo. Bids Apr. 17.

N. Y., West Milton—Chicago Bridge & Iron Co., 2492 McCormick Bldg., Chicago 4, Ill., CA, $2,146,000, bell shaped steel bldg. to house model atomic submarine power plant for Knolls Atomic Plant operated by General Electric Co., River Rd., Schenectady, N. Y. U. S. Atomic Energy Comn., Box 1069, Schenectady, N. Y. Bids May 5.

Oregon—Woodward Governor Co., 5001 N. 2 St., Rockford, Ill., LB $122,289, three turbine governors, Lookout Point Dam Power House, CIVENG 35-026-52-175, Lane Co. U. S. Eng., Pittock Block, Portland, Ore. Bids May 1.

Pa., Phila.—Ross Electrical Constr. Co., 106 Fairmount Ave., Phila., Pa., LB $946,791, High voltage distr. sys. at International Airport. Dpt. Procurement, City Hall Annex, Phila., Pa. Bids Dec. 14.

South Dakota—Pennsylvania Transformer Co., Canonsburg, Pa., CA $110,345. Schedule 1, three 8,333-kva transformers with spare parts for Huron sub-station, Missouri River Basin Proj. Transmission Div., Spec. DS-3645. Bureau Reclamation, Dpt. Interior, Bldg. 1 A, Denver Federal Center, Denver, Colo. Bids Mar. 11, awarded Apr. 30.

Texas—Mid-State Constr. Co., 11626 Harry Hines Blvd., Dallas, Tex., LB $129,927, est. $60,000, 10 mi. new rural distr. lines, conversion 91 mi. existing distr. lines, Coleman Co. Coleman County Co-operative, Inc., Coleman, Tex. Bids Apr. 4.

Tex., Dallas—Dallas Power & Light Co., Dallas Power & Light Bldg., Dallas, Tex., Purchase and Hire, $392,500, electric sub-station, in Pleasant Grove.

Tex., Dallas—Dallas Power & Light Co., Dallas Power & Light Bldg., Dallas, Tex., Own Forces, $135,000, 12,000 volt transformer unit at Wall St. Sub-station.

Tex., Houston—E. Lee Bond, 3131 University St., Houston, Tex., CA, Approx. $400,000, Television-radio center, KPRC and KPRC-TV Television-Radio Center, c/o Lamar Hotel Studios, Houston, Tex.

Wash., Bremerton—P. S. Lord Mechanical Contractors, 4507 S. E. Milwaukie St., Portland, Ore., LB, $280,120, furnishing, installing 150,000 lb. per hour power boiler and auxiliary equipment at Puget Sound Naval Shipyard Spec. 30386, Yards & Docks Annex Navy Dpt., Arlington, Va.

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

La., Pointe a la Hache—Sid Richardson, Fort Worth National Bank Bldg., Fort Worth, Tex., ammonia plant, $19,000,000.

N. J., Hammondton—U. S. Govt. Air Material Command, c/o Dpt. Army, 121 N. Broad St., Phila., Pa., plans by L. P. Kooken Co., 46 W. High St., Carlisle, Pa., aircraft and maintenance depot, $75,500,000.

Tex., Beaumont—Gulf States Utilities Co., 362 Liberty St., synthetic ammonia plant, $16,500,000.

Tex., Houston—Latimer Murfee & Assoc., 2nd Natl. Bank Bldg., shopping center, 20-40 acre tract fronting partly on Main St. $5,000,000.

Wash., Seattle—Dpt. Air Force, Pentagon Bldg., Wash., D. C., 422x922 ft. material preparation bldg. and 126x422 ft. maintenance, transportation and boiler bldg., to be occupied by Boeing Airplane Co., $6,500,000. The Austin Co., 16112 Euclid Ave., Cleveland, O., consult. engr. B. Axman, c/o owner, plant engr.

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FIRST NAME IN BRUSH KILLERS

EXTRA CREEP for EXTRA KILL with

LOW VOLATILE BRAMBLE-WEEDICIDE

Bramble-Weedicide contains H-31, the Thompson patented creeping agent because field tests prove it definitely steps up killing effect.

Woody growth control is also intensified by the use of low volatile pentyl esters. The molecular structures are absorption-rated to assure greatest herbicidal effect. For these reasons, Bramble-Weedicide is more effective and economical than older chemical controls.. first choice of more and more utilities.

Whether you spray by truck, tractor, knapsack, plane or basal bark . . . specify Bramble-Weedicide.

Thompson manufactures many types of brush and weed killers. Write for helpful information on specific problems.

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BRAMBLCIDE is the Thompson low volatile pentyl esters of 2, 4, 5-T fortified with H-31 for extra killing surface creep. BRAMBLCIDE is used for controlling mesquite, huisache, McCartney's rose, osage orange, prickly pear, oak, post, and black jack either by foliage spray or basal stem. Some utilities report that despite a slightly higher cost, (a smaller quantity is needed) it is the preferred herbicide for basal bark or stump treatment.

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You can depend on Safety-Pull Ratchet-Lever Hoists to fully protect men and equipment. They are factory-tested at 100 percent overload. With dual ratchet and pawl, load cannot slip or drop. Hooks are specially designed, alloy steel — will not break or straighten out.

Coffing Safety-Pull Ratchet Lever Hoists
Ten models—capacities from 1,500 lb. to 15 tons.

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Heavy-duty construction keeps Coffing Safety-Pulls on the job...out of the repair shop. Hoist frame and handle are certified malleable iron. Sprocket and ratchet are special alloy, heat treated for longer life. These and other construction extras keep Safety-Pulls working under hard, continual use.

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BOOK REVIEWS

Conduction

The Conduction of Electricity through Gases. **K. G. Emeleus. Published by John Wiley & Sons, Inc, New York 16, N. Y. 99 pages, illustrated. Price $1.50.**

This is a third-edition revision of a monograph first published in 1929. The latest changes are oriented toward a better realization that conduction through gases has become recognized as a much more complex matter than earlier analysis had seemed to indicate. Present attitude is reflected in the mood that the best that can be done is to focus on the dominant factors for framing and phrasing the current hypotheses.

Piping

Piping Design and Engineering. **Published by Grinnell Co, Inc, Providence, R. I., 221 pages, illustrated. Price $10.00.**

Formulas, chart, tables of data, sample calculations constitute more than 90% of the pages. From them the designer can ascertain conformity with code requirements, expansion forces, anchoring stresses, centers of gravity of configurations, velocities and pressure drops, pressure-temperature limitation. Text matter is solely terse interpretation of the accompanying data. General tables not specifically piping close the book in 40 pages.

Electronics

Fundamentals of Electronics. **F. H. Mitchell, Published by the Addison Wesley Press, Inc, Cambridge, Mass. 236 pages, illustrated. Price $4.50.**

For students who plan to major in electronics and for students who will be associated with electronics through the field of measurements, this book provides a firm foundation that is simple to grasp. Little attempt is made to develop theory by rigorous mathematical proof; physical reasoning, refreshingly informal for the subject, is relied upon. However, it is assumed that most students will have some knowledge of calculus.

The first two chapters present a review of circuit theory as an introduction to the remaining material. In following chapters are covered such subjects as electron emission, the diode rectifier, the triode voltage amplifier, power amplifiers, oscillators and gas filled tubes. The final chapter treats of the electronic voltmeter and the cathode ray oscilloscope in instrumentation.

To guide the student, questions and problems are presented at the end of each chapter. Answers to the problems are given in the back of the book.

Electrical Engineering

Principles of Electrical Engineering, Fourth Edition. **By William H. Timbie, Vannevar Bush and George B. Hoadley. Published by John Wiley & Sons, Inc, New York. 618 pages, illustrated. Price $6.50.**

Revision of the previous edition was felt necessary by the authors to keep this basic text up to date for students in electrical engineering. The general plan emphasis is placed upon the application of the theories underlying electrical engineering to practical problems in power and communications. That the authors have succeeded in bringing this fourth edition up to date is attested by the complete rewrite of a majority of the book.

Applied Mechanics

Applied Mechanics for Engineers. **By Sir Charles Inglis. Published by Cambridge University Press, New York. 404 pages, illustrated. Price $7.50.**

This text is the outgrowth of a series of lectures delivered by the author to students working for an honour's degree in Engineering at Cambridge University. Any thought that the book is stiff and

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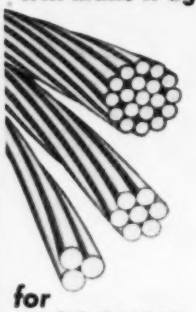

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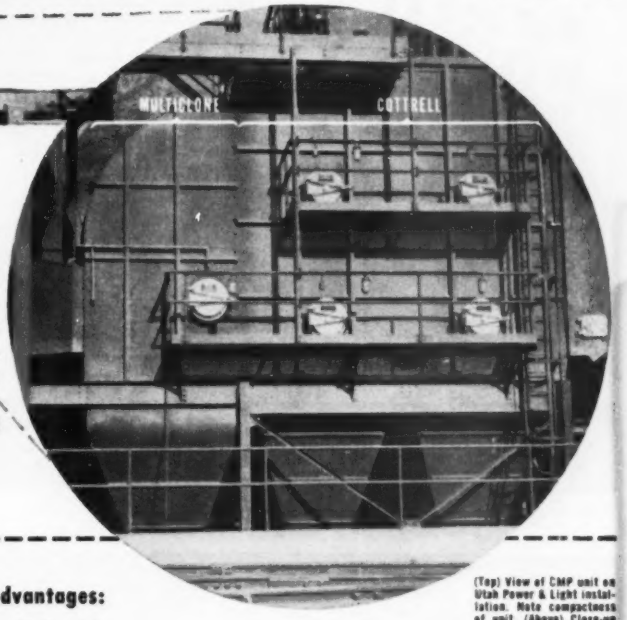
Planning A Fly Ash Recovery Installation?

Consider these important advantages of a WESTERN PRECIPITATION CMP UNIT!



(Top) View of CMP unit on Utah Power & Light installation. Note compactness of unit. (Above) Close-up of same installation.

IF YOU are planning the installation of any type of fly ash recovery equipment—mechanical or electrical—it will pay you to investigate the extra advantages to be gained by installing a CMP Unit designed, engineered and constructed under *one* responsibility by Western Precipitation Corporation—*leaders in both electrical and mechanical recovery fields!*

Combines Mechanical and Electrical Advantages:

A CMP (Combination Multiclone-Cottrell Precipitator) Unit combines—in one compact installation—both mechanical and electrical recovery principles, so that maximum benefit is obtained from the advantages inherent in each method. The MULTICLONE section centrifugally cleans the gases of the larger and heavier fly ash particles (down to a few microns in diameter)... and the COTTRELL Precipitator then electrically removes the very small particles remaining in the gases. This combination arrangement has important advantages:

1. Using the MULTICLONE for cleaning out the heavier particles permits the bulk of the recovery operation to be performed with relatively low-cost equipment.

2. Using the COTTRELL for final clean-up insures unusually high recovery efficiency—approaching theoretically perfect, if desired—with a high efficiency, compact Precipitator unit.

3. Each type of unit—MULTICLONE and COTTRELL—can be arranged for its most efficient application. MULTICLONES may be connected to each separate boiler, if desired, and their draft requirement cut out when the boiler is down... while a central COTTRELL handles all gases and operates at higher efficiencies, with continued low power cost, when one or more boilers are down.

4. During soot-blowing periods, or while warming up cold boilers, the MULTICLONE efficiency usually increases, preventing overloads of detrimental carbon from reaching the COTTRELL.

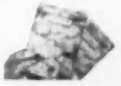
Only Western Precipitation Combines Multiclone and Cottrell "Know-How"—In ONE Organization!

A vital factor in obtaining maximum efficiency and economy in CMP installations is the proper balance of mechanical and electrical recovery equipment to the individual requirements of *each* application. Western Precipitation is unique in that it not only pioneered the commercial application of COTTRELL Electrical Precipitators over 43 years ago, but also has been a leader for many years in the *mechanical* recovery field with its widely-recognized MULTICLONE Collectors.

Result—Western Precipitation has the all-important "know-how" and experience in BOTH fields... knows from first-hand experience how to fit the *right* equipment in the *right* place, to do *your particular* job ... and can provide the complete installation under ONE responsibility and ONE overall guarantee!

Let Our Experienced Engineers study your recovery requirements and make recommendations on the equipment best suited to your operations. A wire, phone call or letter to our nearest office places this unique "Know-How" at your service, without obligation!

Send for descriptive literature!



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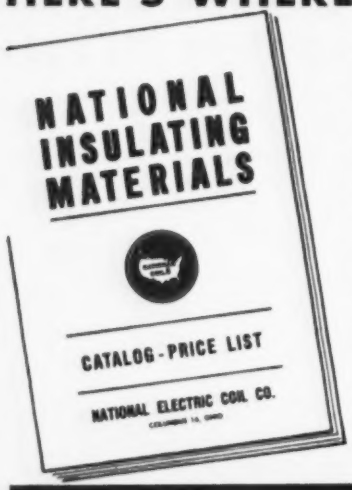

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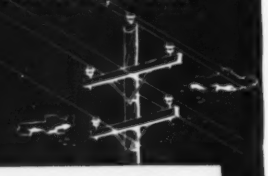

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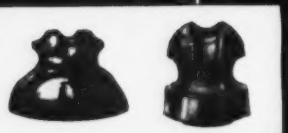

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formal should be quickly discarded as the author has succeeded in preparing an interesting and engrossing discussion of the principles of static and kinetics. The text is amply filled with examples and problems drawn from practical applications.

The work is not designed as an introduction to the subject because it assumes some knowledge of the fundamental principles of statics, theory of structures and dynamics. It assumes the student to have mastered the techniques of calculus and straight-forward differential equations.

To keep the book within reasonable limits, the author touches only lightly upon the subject of fluid mechanics and becomes involved in the problems relating to mechanisms only to the extent that they involve no deeper concept than the existence of an instantaneous center of rotation.

Forecasting Markets

Business Forecasting. **By Frank D. Newbury. Published by McGraw-Hill Book Co., New York. 36 273 pages, illustrated. Price $4.75.**

Market forecasting as a science and a practical managerial tool is thoroughly covered in this book. The sources of data and their function are adequately described for the beginner, and case studies along with analysis of methods gives ample material for the practicing researcher.

Adaptation of the principles to electric power industry forecasts and market research is indicated but not specifically covered. Business forecasters for this industry will profit by a study of these general principles.

Electrical Engineering

Electrical Circuits for Engineers. **By Edward K. Kraybill. The Macmillan Company, N. Y. 199 pages, illustrated. Price $3.25.**

Founded upon the contention that few engineers, regardless of their specialty, can proceed successfully without a knowledge of the rudiments of electricity, this textbook introduces the engineering student to the basic theory of electrical engineering. The author has chosen to present steady state circuit theory by combining ac and dc relationships into one discussion rather than the classic method of separate presentations. This approach eliminates not only unnecessary repetition but also many factors that tend to confuse the reader.

By profuse use of analogies, the author has attempted to make the fundamentals of electricity easier to grasp. Of particular interest are the illustrative problems, the concise summary and the good selection of references presented at the ends of the chapters.

Electrical Engineering

Alternating Current Circuits, **third edition. By Russell M. Kerchner and George F. Corcoran. Published by John Wiley & Sons, Inc, New York. 586 pages, illustrated. Price $5.50.**

In revising the second edition, the authors have improved upon an already very valuable text for students majoring in either power or communications curriculums. More important revisions include discussion of circuit analysis by the nodal method; the addition of a method of designing tuned coupled circuits with a certain decibel variation over a desired band width; and discussion of the three origin vector diagram of a polyphase circuit.

Industrial Selling

Selling to Industry **by Bernard Lester. Published by The Industrial Press, New York 13, N. Y. Price $3.50.**

Slanted to the equipment sales engineer, this book is full of sales philosophy and practical ideas. By using ample illustrations, the author presents the subject in a most forceful and readable way. Careful reading will provide great reward for the beginner and many new ideas for the experienced sales engineer.

More Power to South America

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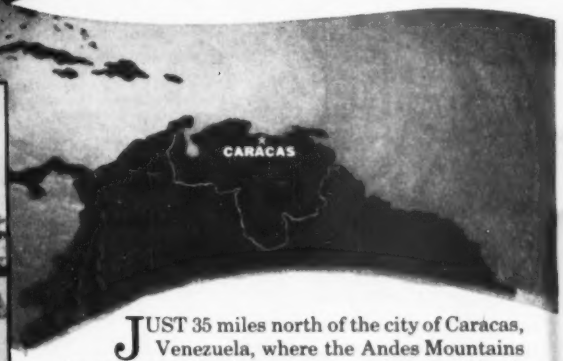
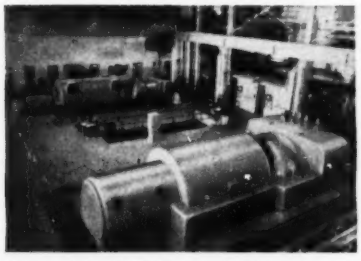


JUST 35 miles north of the city of Caracas, Venezuela, where the Andes Mountains rise from the Carribean, a new, modern building is nestled in a small valley on the seacoast. This building contains a *40,000 kilowatt* steam electric power station which ties into the distribution system serving the industrial and residential needs of the Federal District of Venezuela.



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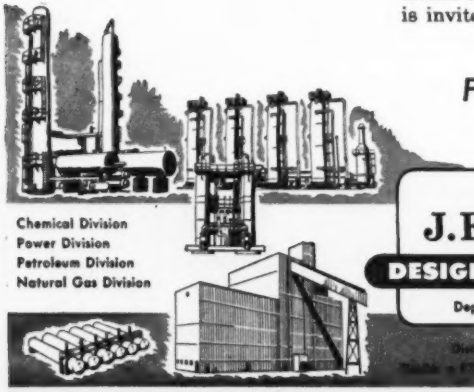

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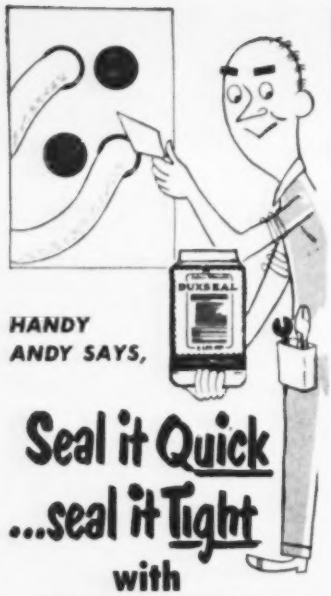

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TECHNICAL LITERATURE

Joint Pole Use—*Joint Use of Poles in Rural Areas* is a report prepared by the Joint Subcommittee on Joint Use of Poles for Rural Power and Telephone Circuits of the Edison Electric Institute and Bell Telephone System. The report reviews the factors concerned in the relative economies of joint construction vs separate power and telephone line construction in sparsely settled rural areas. It also makes recommendations concerning further joint work on rural joint use matters. Publication 51-19 available from Edison Electric Institute, 420 Lexington Ave, New York 17, N. Y.

Plastics Standards—New NEMA *Standards for Laminated Thermosetting Plastics* publication LP1-1951, has just been released. Information concerning the manufacture, test and performance of laminated thermosetting sheets, rods and tubes is covered. Data are also given on paper, fabric, asbestos, glass and nylon base grades. Available at $1.00 a copy from National Electrical Manufacturers Assoc, 155 E 44 St, New York 17, N. Y.

Nickel Alloy Cast Irons—A 36-page bulletin recently released describes eight types of austenitic nickel alloy cast irons that offer unique combinations of properties. Applications and comparative service data in many industrial fields are presented to prove its utility in withstanding corrosion, heat, wear and low temperature. A reference booklet, it is well illustrated and also has tables of properties and corrosion data on nearly 400 conditions. International Nickel, Dept EZ, New York 5, N. Y.

Ampco Alloys—*Aluminum Bronze P1-A*. A completely revised 20-page bulletin has been released giving complete information on Ampco alloys as applied in corrosion resistant service and cavitation-pitting data along with physical and chemical properties of various aluminum bronze alloys recommended for such service. Free to obtain. Write to Ampco Metal, Inc, 1745 South St, Milwaukee 46, Wisc.

Nema Standards—New standards have been released by Nema for *Laminated Thermosetting Products No. LP1-1951 and No. 103-1951*, standards for test blocks and cabinets for installation of self-contained "A" base watthour meters. Available from National Electrical Manufacturers Association, 155 East 44 St., New York 17, N. Y.

Low Temperatures Silver Brazing—A 48-page pocket-size manual, the *"Complete Guide to Successful Silver Brazing,"* on low temperature silver brazing includes 50 drawings and charts. Questions and answers. Copies can be obtained upon request from American Platinum Works, 231 New Jersey Railroad Avenue, Newark, N. J.

School Lighting—A booklet *ABC Plan School Lighting* has just been issued by Westinghouse. Complete data and layouts, photos and descriptions is provided for eight sample lighting layouts. For a copy, write for booklet B-4556-A, Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

Industrial Management—The *Proceedings of the 15th Annual Time and Motion Study and Management Clinic* sponsored by the Industrial Management Society are now available. The 128 pages include forms, illustrations, and transcripts. Published by the Society, 35 E. Wacker Drive, Chicago 1, Illinois. Price $4.00.

Non-Fusion Welding—Now available, free upon request is an 8-page technical paper *Dilution and Diffusion Aspects of Non-Fusion Welding*. Profusely illustrated and documented with charts, diagrams, tables and formulae derivations, it can be obtained by writing, Eutectic Welding Al-

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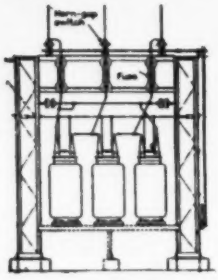

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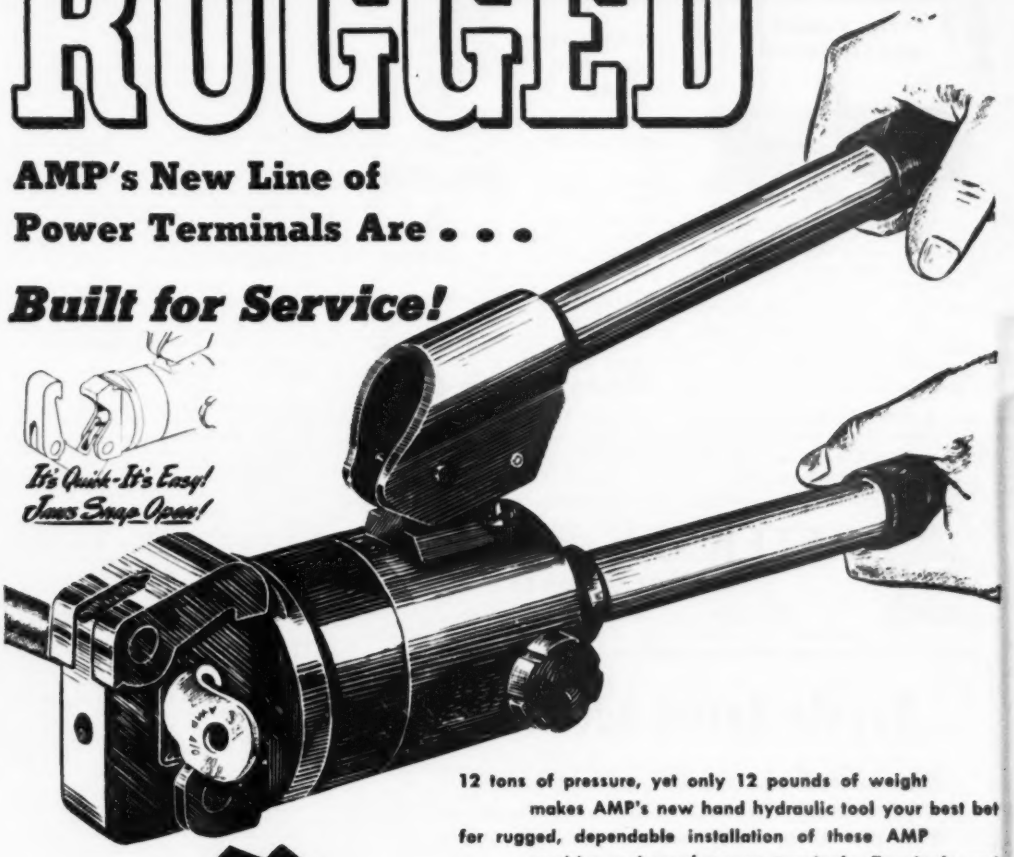

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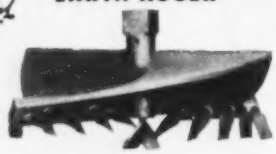

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loys Corp, Dept P, 172 St and Northern Blvd, Flushing, N. Y.

Electric Equipment—A new booklet B-4695, describing electric equipment for arc furnaces has been made available. It discusses application of electrical equipment to both submerged and direct furnaces, in steel mills, chemical plants, foundries and nonferrous metal refineries. A copy may be obtained by writing Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

Composite Catalog—Catalog No. 5000, consisting of 28 pages, describes the principal instruments, control devices and related components manufactured by the Industrial Division of Minneapolis-Honeywell Regulator Co. The booklet which includes 100 measuring and control instruments and valves can be obtained by writing to the company, Wayne and Windrim Aves, Philadelphia 44, Pa.

Instrument Shock Testing—*Instrument Shock Testing Theory and Measurement* is the title of a 4-page booklet containing calculations, operation, and instrumentation, fully delineated and oscillograms of a complete range of shock tests. It was released by Haines Designed Products Corp, 117 No Findlay St, Dayton 3, O.

Electrical Maintenance—Section 27 of Westinghouse Electric Corp *Hints on Electrical Maintenance* is now available and may be procured from the company, Pittsburgh 30, Pa. It deals exclusively with safety rules for electrical maintenance and construction workers.

Tool Steel—A 197-pg volume, the *Tool Steel Handbook*, designed for engineers, teachers, metallurgists and others interested in tool, die and allied steels has been published by the Allegheny Ludlum Steel Corp, 2020 Oliver Bldg, Pittsburgh 22, Pa. Free copies will be sent to qualified persons upon request.

Anti-Friction Bearings — Concentrating solely on the many and varied problems of maintenance of anti-friction bearings the *"AFBDA" Bearing Maintenance Report* will be offered again without charge during 1952 to men within the industry. Copies of the report may be procured from the Anti-Friction Bearing Distributors Association, 1900 Euclid Ave, Cleveland 15, Ohio.

Membership Director—Five hundred and fifty-eight companies and three trade associations representing the electrical manufacturing industry are listed in the ASA membership roster. The *ASA 1951 Annual Membership Directory* is available from the American Standards Association, 70 East 45 St, New York 17, N. Y.

Distribution Fuse Links — The *E.E.I.-NEMA Standards for Distribution Fuse Links* is now available. It includes scope, current ratings, meeting time-current characteristics, curves and definitions and may be obtained from the Edison Electric Institute, 420 Lexington Ave, New York 17, N. Y.

Guy clamps—Publication *"TD-21 1951, Specifications for Guy Clamps"* approved by the Transmission and Distribution Committee of the EEI is now available. It may be obtained from the Edison Electric Institute, 420 Lexington Ave, New York 17, N. Y.

Vinylite Resin Plastigels—*Technical Data on Vinylite Resin Plastigels* with photographs illustrating their properties and their possibilities are included in a new pamphlet now available. Copies may be obtained from the Bakelite Div, Union Carbide and Carbon Corp, 300 Madison Ave, New York 17, N. Y.

NEMA Standards—A revised bulletin has recently been issued entitled *Nema Standards for Unit Substations* No. 201-1951 to 205-1951. Write to National Electrical Manufacturers Association, 155 East 44 St., New York, N. Y.

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CATALOGS • BULLETINS

● POWER DRIVES: An illustrated 20-pg catalog of electric power drives has recently been issued. It contains complete descriptive information on variable speed drives, geared motors and constant normal speed motors in drip-proof, splash-proof, totally-enclosed and pipe-ventilated designs. Available from Sterling Electric Motors Inc, 5401 Anaheim-Telegraph Rd, Los Angeles, 22, Calif.

● INSULATION TESTER: Designed to give quick information on all precision instruments manufactured by Associated Research Inc, 3760 West Belmont Ave, Chicago, Ill, Bulletin 10A has just been released by that company. It includes basic data on "Vibrotest" for electric insulation resistance testing and "Vibroground" for ground resistance testing. Available upon request.

● ELECTRICAL FARM EQUIPMENT: Twenty three pieces of electrical farm equipment that can be easily built from inexpensive materials found around the farm, are described in a new 32-pg booklet just released. Included in the booklet are easy-to-understand sketches and diagrams illustrating construction details. For a copy write for B-4770-2, School Service Dept T, Westinghouse Electric Corp, Box 1017, Pittsburg 30, Pa.

● RADIO STROBOSCOPES: An explanation of how the stroboscope works is given, together with specific applications of the different instruments in a new 8-pg bulletin. Copies may be obtained from the General Radio Co, 275 Massachusetts Ave, Cambridge 39, Mass.

● CONNECTORS: A new simple reference chart has recently been issued to show what is now available for aluminum and aluminum to copper connections. Designed to answer questions in the aluminum field it can be obtained from the manufacturer, the Fargo Mfg Co, Poughkeepsie, N. Y.

● METAL WALLS: The efficient, economical way to solve space problems is explained in a new 48-pg book entitled "Mobilized Interiors," Catalog No. 52. Designed specifically as a working tool for architects, engineers, contractors and building professionals, it may be obtained by writing the Mills Co, 975 Wayside Rd, Cleveland 10, Ohio.

● MOTORS: Design and application features of life-line motors, now made in ratings up to 700 horsepower, are described in a new 20 page book recently made available. Applications in the paper, chemical, central-station, mining, lumber and metal working industries are fully illustrated. Write for booklet B-4731, Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

● ARC WELDING: Three new bulletins on arc welding accessories have been announced as available from the General Electric Co, Schenectady 5, N. Y. The illustrated brochure describes recommended protective clocking (GEC-867), helmets and glass (GEC-865), brush carriers, clipping hammers and weld gages (GEC-866). Copies are available upon request.

● INSULATION FAULT LOCATOR: Complete information on the industrial electronic single comparison tester is now ready in an 8-pg booklet. The tester, used mainly to locate insulation faults and winding dissymmetries in various electrical apparatus is fully shown in the booklet DB85-960 which has recently been released by Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

● MINIATURE LAMPS: A new 36-pg bulletin designated "Miniature Lamp Catalog," listing and illustrating hundreds of types of miniature lamps and their applications has recently been issued. Vital statistics including size, life, voltage and cost of each lamp is also included in this three color booklet distributed by General Electric Lamp Div, Nela Park, Cleveland, Ohio.

● CONVEYING EQUIPMENT. The standardization of their brochure, which contains literature on all their equipment and a photographic study of their facilities was recently announced by Island Equipment Corp, 27-01 Bridge Plaza No, Long Island City, N. Y. Brochures will

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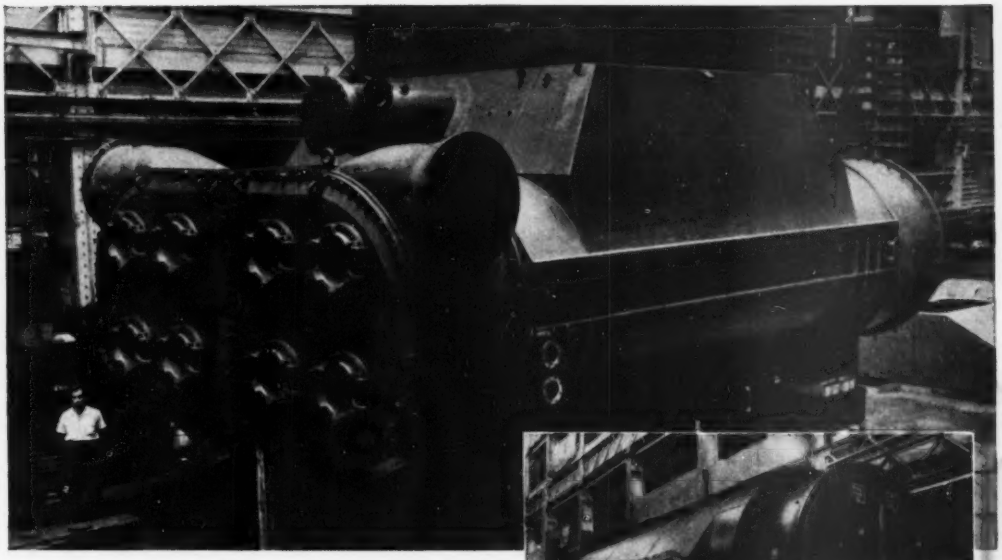

LOW-HEADROOM, OVAL-TYPE CONDENSER (with extraction heater in exhaust neck), is typical of several furnished in sizes ranging from 27,500 to 80,000 sq. ft.

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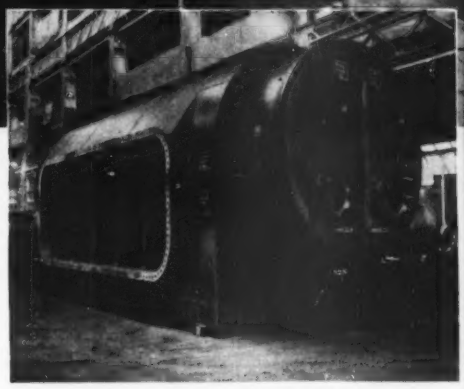
Low-headroom design for condensers typical of Worthington "space" engineering



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That was the year the first Worthington condenser was installed. From that time, up through the early twentieth-century "evolutionary" period in condenser design, Worthington has constantly kept in step with prime mover and steam power plant development. Today, engineers must design and build condensers within the limitations imposed by high construction costs.

Thanks to the flexible nature of the Worthington "Double Folded Tube Layer", today's "low-headroom" requirements are easily met without any sacrifice in efficiency. For single-shell, beneath-turbine installations, the rectangular box-type (built by Worthington as early as 1904) has given way to the modern "oval" design illustrated above. Other designs include single-shell, side-mounted units with exhaust elbows, and twin shells with horizontal or "T" shaped exhaust connections, popular for outdoor or semi-outdoor plants.

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● INSULATING PAPERS: Rag, part rag, wood pulp, rope papers, pressboards and electrical fibre for electrical insulation are described in a free 12-page catalog recently released. Fabricated and cellulose acetate paper combinations are also covered along with complete technical data in the booklet issued by Insulation Manufacturers Corp, Publications Dept, 565 West Washington Blvd, Chicago 6, Ill.

● RESISTORS: Properties, performance characteristics and detailed application on negative temperature coefficient resistance units are presented in No. 12, a new 8 page technical bulletin. Types, dimensions, nominal voltage ratings and time constants for the standard sizes are tabulated in this booklet published by Keystone Carbon Co, St. Marys, Pa.

● FUEL OILS: The E F Drew & Co, Inc, 15 East 26 St, New York 10, N. Y. has announced the availability of a folder on the problems concerned with the burning of modern fuel oils and the application of additives. This folder presents data and information on the elimination of sludge, soot, and slag in the burning of industrial fuel oil.

● GAS AND AIR TURBINES: The Pyle-National Co, 1334 North Kastner Ave, Chicago 51, Ill. has just completed six new bulletins describing the company's line of high efficiency impulse type steam gas or air turbines for mechanical drive. One bulletin provides general turbine information and each of the other five is devoted to five different types from ¼ to 120 hp.

● FREQUENCY STANDARD: A new 8-pg bulletin has just been distributed outlining the specifications of the Type 1213-A unit crystal oscillator, a simplified frequency standard for the small laboratory. If any further information on the folder itself is desired, write the General Radio Co, 275 Massachusetts Ave, Cambridge 39, Mass.

● ALUMINUM CONNECTORS: A 32-pg catalog, "T&B Method Compression Joints for Copper and Aluminum Cable," has just been issued. It shows new aluminum connectors as well as copper fittings and it is of special interest now that aluminum cables are finding increasing use. An illustrated quick-ordering chart is included with the catalog. Request copies of Bulletin 67 from the Thomas and Betts Co, Elizabeth 1, N. J.

● MOTOR-GENERATORS: Bulletin 20-210 describes in 14 pages with 43 illustrations a complete line of low voltage, direct current motor generators for electrolytic processes. Sleeve bearing and ball-bearing construction are presented plus a short history of the development of today's electrolytic motor generators. Copies are available from the Electric Products Co, 1725 Clarkstone Rd., Cleveland 12, Ohio.

● SOCKET MANUAL: A revised edition has just been released of "Triple Index," a socket manual which contains socket connection diagrams for more than 660 receiving tubes and kinescopes, including recently announced types. Specially designed to provide information at a glance, the new booklet may be obtained from all RCA tube distributors and from the Commercial Engineering Div, Radio Corp of America Tube Dept, Harrison, N J at 75 cents per copy.

● HERBICIDES: A new chart embodying the latest information on chemical control of weeds and brush has been prepared by Thompson Chemical Corp, St. Louis 3, Mo. The chart free of charge furnishes data on what to spray, when to do it, and what dilution to use. It includes directions for both foliage spray and basal bark treatment.

● MAGNETIC PROPERTY MEASURE: A new bulletin showing the application and operation of equipment used for measuring magnetic properties has just been released. Designated as GEC-777, the publication describes the GE gauss meter, indicating fluxmeter, recording fluxmeter and flux meter calibrating unit. Write the General Electric Co, Schenectady 5, N. Y.

● INDUSTRIAL FURNACES: A new booklet, "Harnessing Heat," describes twelve different types of furnaces, both gas and electric and outlines their chief field of application. The bulletin, which also contains several pages concerning material handling methods in furnaces and

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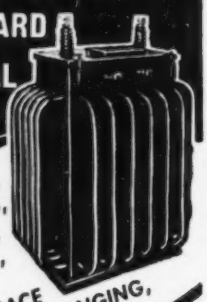

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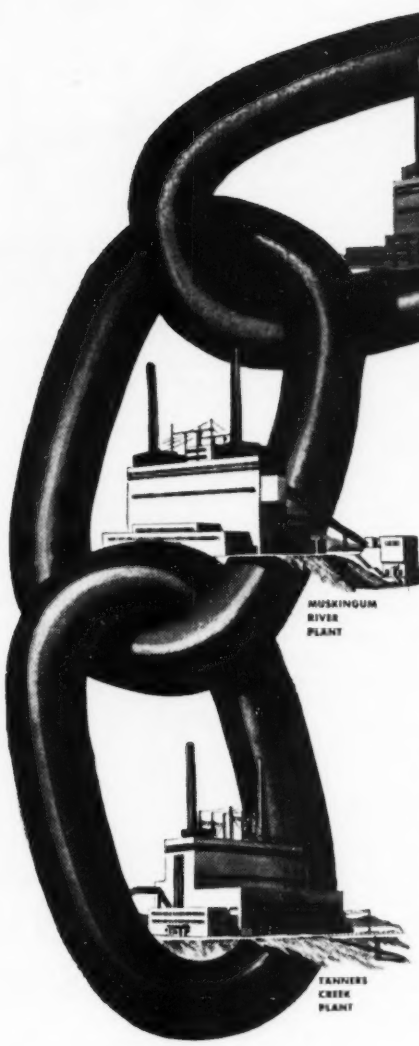

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a glossary of heat-treating terms, may be obtained from the Westinghouse Electric Corp, Box 2099, Pittsburg 30, Pa.

● BATTERY CHARGERS: Bulletin 16-210 describes and illustrates the full line of Type S single circuit motor generator battery chargers for industrial batteries. It contains a simplified listing that facilitates selection of the right charger for any popular size truck battery. Copies are available from Electric Products Co, 1725 Clarkstone Rd, Cleveland 12, Ohio.

● INDUSTRIAL EQUIPMENT: "RCA Products for Industry," a new 28-pg illustrated booklet describing major industrial equipment, has recently been issued. The brochure contains such items as electron microscopes, and electron diffraction equipment, precision instruments and vacuum systems. It may be obtained from the Industrial Equipment Section, Engineering Products Dept, Radio Corp of America, Camden 2, N. J.

● METAL PROTECTION: A new catalog describes the Kromover touch-up pencil which is an easy tool for tinning hard-to-tin surfaces, rust-proofing metal, and regalvanizing spots where damage has destroyed original surface. Write to All-State Welding Alloys Co, Inc, 249-255 Ferris Ave, White Plains, N. Y.

● PERMANENT MAGNETS: A complete listing of stocked sizes and shapes of Carboloy Alnico permanent magnets is included in Bulletin PM-100 now available from Carboloy Dept of General Electric Co, Detroit 32, Mich. The illustrated, 20 pg bulletin contains pull curve and size information in tabular form on stocked types of permanent magnets.

● DURALUMINUM LADDERS: A folder describing the improved safety feature of Duraluminum life-time straight and extension ladders has been released recently. Details of rung construction, siderails, safety locks and safety shoes are shown and explained. Duraluminum Mfg Co, 110 West 34 St, New York 1, N. Y.

● WIRING: "Rx for a Building with Hardening of the Arteries" is the title of a 12-pg booklet recently released by Rockbestos. It describes the advantages of AVC cable for increasing conduit capacity without increasing conduit size—thus saving the extra expense of a completely new electrical system. Rockbestos Products Corp, New Haven 4, Conn.

● WIRING DEVICES: A new 96-pg catalog listing a complete line of wiring devices for industrial, commercial and residential use has been prepared by Leviton. Over 1,000 items are listed and fully described. Dimensions and wiring diagrams are very helpful to architects, contractors, and designers of lighting equipment. Leviton Mfg Co, Brooklyn 22, N .Y.

● MEASURING EQUIPMENT: Measuring and production line equipment is summarized in GE's new 30-pg catalog. To be used primarily as a reference to apparatus available for complex measurements to be made in industry, GEC-1016 contains more than 150 photographs and diagrams, and describes the uses, features, specification and prices of more than 130 GE testing and measuring devices. General Electric Co, Schenectady 5, N. Y.

● DRY TYPE TRANSFORMERS: Allis-Chalmers released a bulletin on openly ventilated dry-type transformers with Class B insulation. This guide gives general recommendations on installation, inspection, storage, maintenance and operation. It includes distribution and power dry-type transformers in ratings above 50 kva and above 600 volts. Bulletin 61X7088B available from Allis-Chalmers Mfg Co, 932 So 70 St, Milwaukee, Wisc.

● PLUGS AND RECEPTACLE PARTS: A new pamphlet has recently been released describing the use of plugs and receptacle parts in railroad shops, pumping stations, mines, machine shops, docks, wharves and mills. Can be obtained by writing Delta Star Electric Co, 2437 Fulton St, Chicago, Ill.

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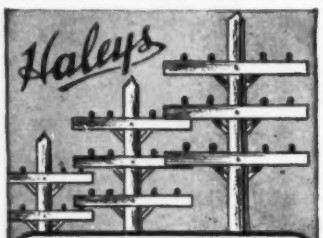

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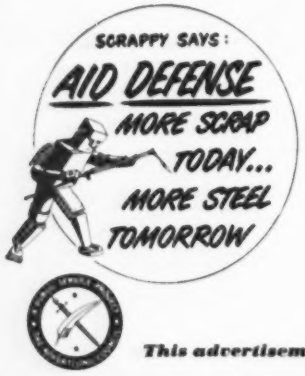

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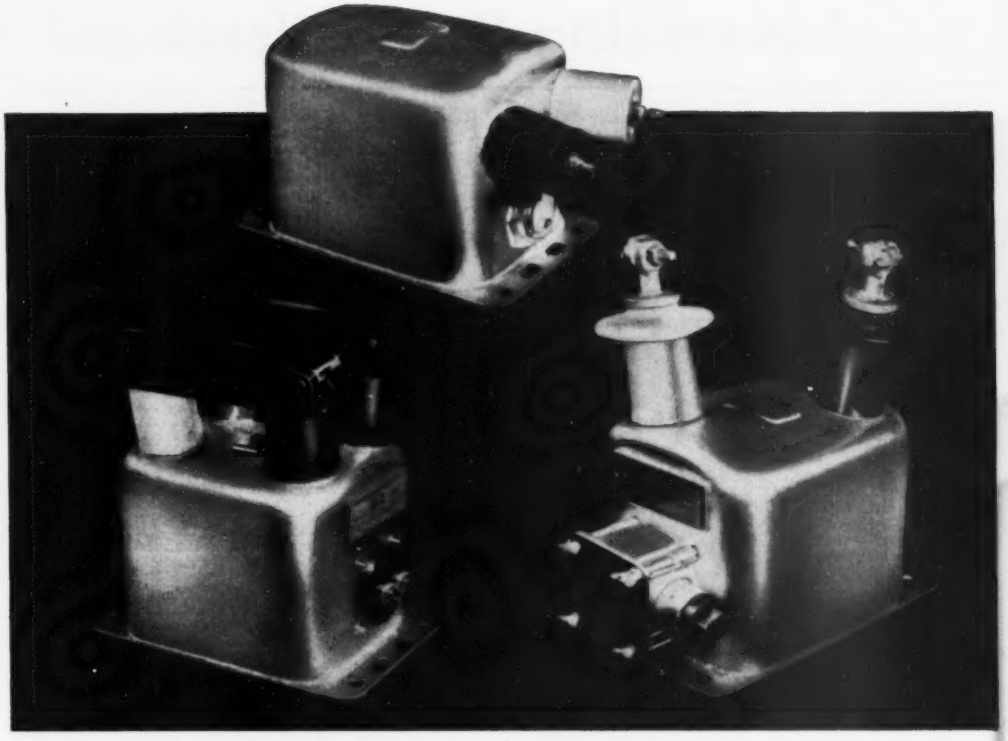

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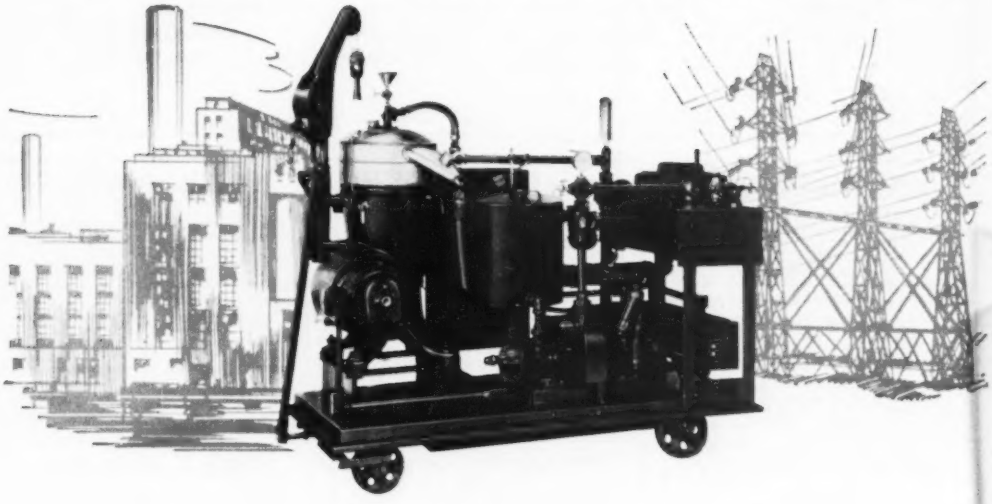
Low Cost Insulating Oil Purification Increases Substation Dependability



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3	75	A. C.	66000/24000—7200/12470 Y
4	2500	West.	44000—11000
3	150	G. E.	44000—7200/12470 Y
3	100	G. E.	44000—2300
3	75	West.	44000—7200/12470 Y
1	8333	West.	43800—13800
1	18750	A.B.B.	34840—11000, 3 ph.
3	100	West.	33000—240/480 NEW
1	100	A. C.	33000—7200/12470 Y
3	75	Wag.	33000—7200/12470 Y
4	650	A. C.	25410/44000—13280/23000
6	100	G. E.	22000—7200/12470 Y
9	50	G. E.	22000—2300
3	37½	G. E.	22000—6900
6	200	G. E.	13200—2300
4	333	Wag.	7200/12450 Y—2300
3	250	Pitts.	7200—220/440
3	100	West.	7200/12470 Y—2400
6	25	Mol.	7200/12470 Y—120/240
3	500	Pitts.	6900/11900—550
3	833	Pitts.	6900/11900—550
3	150	Wag.	6900—2300
3	200	G. E.	6900/11430—575
3	37½	G. E.	6900—230/460
2	150	West.	4800/8315 Y—480
2	100	G. E.	4800/2400—480/240
3	333	G. E.	2300—230/460
1	100	G. E.	2300—675, 3 ph.
3	100	West.	2300—460/230
3	75	Mol.	2400—120/240
2	50	West.	2400—114/228 DRY TYPE
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1— 600 A. 37 KV G. E. FHKO-236-500 MVA
1—1200 A. 15 KV G. E. FKO-139-350 MVA
1— 600 A. 15 KV G. E. FKO-139-350 MVA
2— 600 A. 15 KV G. E. FHKO-136-1328 BS
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1—	400	Westg.	Non-condensing — 125/150 lbs. I.S.P. 5/10 lbs. B.P. — 240/480 v. 3 ph. 60 cy.
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SYNCHRONOUS CONDENSERS

KVA	Make	Type	Volts	Speed
1—5000	Whse		2400/4160	600

MOTOR GENERATOR SETS

3 ph. 60 cy.

Qu	KW	Make	Speed	DC Volts	AC Volts
2—	2000	G.E.	360	600 23 cy	11000
1—	1500	G.E.	720	600	13200
1—	1500	G.E.	360	275	2300/4600
1—	1000	G.E.	900	250	4160/6900
1—	1000	G.E.	600	600	2300/4150
2—	1000	Whse.	900	600	2300/4150
1—	500	Whse.	900	250	6600, 13200
1—	500	Whse.	1200	125/250	2300
1—	500	Whse.	900	250	440
1—	500	G.E.	720	125	2300
1—	400	G.E.	720	250	440/2300
1—	250	G.E.	900	125	4150
1—	150	G.E.	1200	275	2300
1—	150	Whse.	1200	275	2300

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KVA	Make	Type	Ph	Voltages
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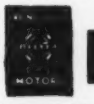
3—1250	G.E.	HT	3	2236x/13200x440/2300
1—1150	A.C.	OISC	3	12500x450/2400
3—1000	G.E.	HVDDJ	1	2300x480
3—	500	A.C.	OISC	1	11500x5600
9—	300	G.E.	HT	3	24000x240/480



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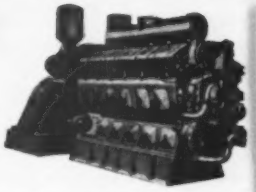

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KVA	Make	Model	HP	RPM	KVA	Make	Model	HP	RPM
1875	Fairbanks Morse	33F18	2600	300	375	Enterprise	1961-6	450	450
1420	Fairbanks Morse	38D8⅛	1600	720	330	Superior	KNA	396	514
1250	General Motors	16-278A	1600	720	312	General Motors	8-268A	450	1200
937.5	General Motors	12-567	1080	720	312	Clark	34D-4	375	327
625	Alco	6-12½x13T	750	600	125	Ingersoll Rand	8	225	514
425	Baldwin	VO-6	510	450	187	General Motors	3-268A	150	1200
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3— 100 KVA Wagner, 1 Ph., 2400 pri., 120Y sec.
2— 100 KVA Newark, 440V 3 Ph., 220V 2 Ph.
6— 50 KVA G.E., 1 Ph., 13,450V. 120/240 Sec.
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LETTERS TO THE EDITOR

Not Dams But Forests

To the Editor:

On Sunday night, April 20, Drew Pearson in his national broadcast, "Prophecy of Things to Come," said: "I prophesy that the electric light companies will, in spite of all the destruction now going on, oppose the Missouri Valley Authority and its plans to control and prevent future floods. . . ."

I am a load dispatcher for the Southern Division of Central Maine Power Co and have been in the business for 31 years—so I am perhaps prejudiced. Also I am a long-time student and sometimes instructor in soil and wild life conservation and that makes me disgusted with Mr. Pearson.

Dams might hold one week's or one month's precipitation, but the basic problem is lack of forests at the headwaters. Forests hold a year's precipitation. We are losing our topsoil and precious land due to fires and public apathy. . . .

Are we as an industry going to let this man, at a dramatic moment in our times, malign us and take it without rebuttal? . . . Are we to go ahead as a Nation or let men like Pearson, who think no farther back than their tonsils, ruin us?

Lovell B. Sawyer
Cumberland Center,
Maine

Controlling the Missouri

To the Editor:

A leading editorial, "Chapman and Utilities Can Solve Missouri Valley Problems," in your April 7 issue, page 89, has to do with power development and flood control in the Missouri River Valley. It seems to me that too frequently we associate generation of power with flood control. Actually, they should not be even remotely connected.

In 1933 Congress appropriated money for a flood control project near the head waters of the Missouri River at Ft. Peck, Montana. The dam was built for the avowed purpose of flood control. I visited the dam in 1941. The U. S. Engineer Corps major in charge of the project pointed out to me where foundations were being built for a power house.

To obtain the necessary head for generating power, such a reservoir as created by Ft. Peck dam must be operated at least partially full. For flood control purposes the reservoir should be entirely empty. I was told the flood control feature had been de-emphasized. It seemed the dam would be more useful if used to regulate the flow of water in the lower river for navigation purposes. At the time, efforts were being made to completely fill the reservoir and I know that it has since been completely filled. Additions have been made to increase the amount of power generated at the reservoir.

The recent disastrous floods in the Missouri Valley were the result of melting snows and rains above Ft. Peck reservoir. I believe this should be made the subject of a Congressional investigation. Was the Ft. Peck reservoir completely filled with water prior to the start of flood conditions or was it empty as it should have been?

Naturally the question comes up as to whether the existing flood control reservoir was capable of being used for flood control, and even more potent, if additional dams are built, will they be used for flood control or will our paternal Government conceive that these too can be used for power generation even though their usefulness as flood control reservoirs is thereby destroyed?

It may be a silly suggestion but would not the money which must be appropriated to build sufficient dams to contain flood waters in the Missouri Valley be sufficient to move every farm house and barn in the valley to high ground where it would not be affected by the flood?

M. Kennedy
1011 Hunters Lane
Philadelphia 31, Pa.

The American Way

To the Editor:

We note with interest your news story in the March 31, 1952 issue entitled "Public Power Agencies Are Menacing Puget Sound P&L."

To an extent the story is factual, but it overlooks the most important factor in the whole situation. The state law, which provides for Public Utility Districts—everyone of the PUDs which surround the Puget territory, every PUD which is actively negotiating for or condemning Puget properties, every present municipal and proposed municipal operation in Puget's territory—was formed by the due processes of a democracy with a majority, free-American vote. It could be added that these votes were taken in opposition to a high-priced advertising campaign on the part of the company.

If the carrying out of a decision made by an American election is to be termed "vicious" and "barbaric," then you have no faith in the American democracy. Surely Electrical World does not accept such views, and the selection of such terms and the omission of this important factor must have been an oversight on the part of your staff.

Ken Billington
Executive Secretary
Washington PUD Association
Seattle 1, Washington

Fabricators Ready

To the Editor:

I was interested in the article "Power Expansion Gets Green Light From NPA," pp 108-109, in the March 24 issue of Electrical World. For the first time I see fabricated piping has been recognized as a greatly needed item in connection with the power expansion program.

I thought you might be interested to know that the fabricated piping industry has plenty of capacity to produce all the requirements of DPA's goals of 1952, 1953 and 1954 and are able to obtain allotments to take care of these requirements. However, the great and pressing problem is to translate these allotments into actual pipe from the mills.

For instance, for the third quarter we have just attempted to place a requirement of 900 tons and were allotted 297 tons. This means the jobs are going to be delayed or this material will have to be picked up at high prices from jobbers' stocks. It is not only our company which finds itself in this position, but all others in the fabricated piping business.

W. M. C. McKee,
Assistant Sales Manager
The M. W. Kellogg Co.
Jersey City 3, N. J.

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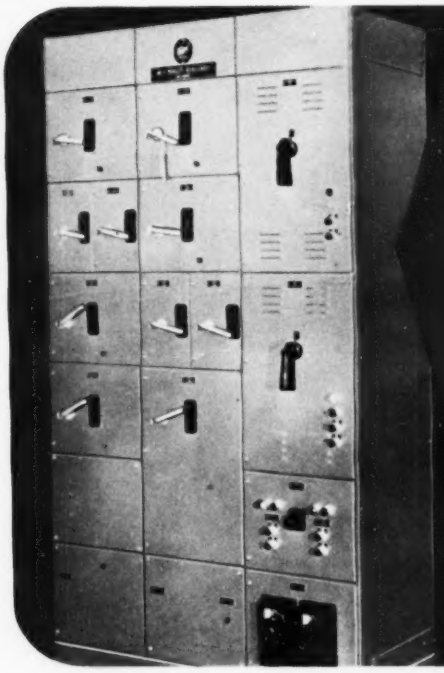

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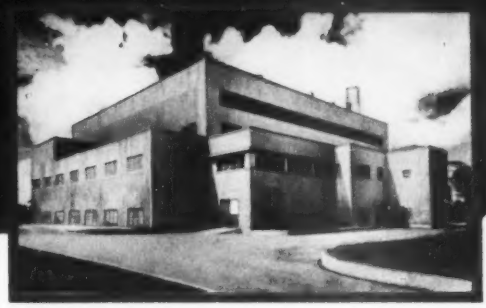

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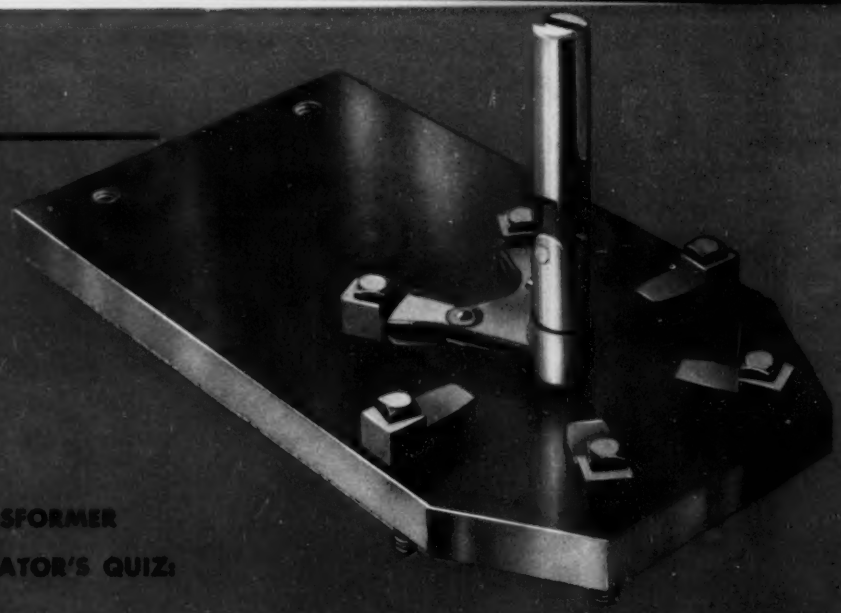

TRANSFORMER
OPERATOR'S QUIZ:

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